Dietary Intervention to Alleviate Acne Severity

Dalia I Tayel[1], Omneya M. Abdelsalam[2], Yehia F Elgarem[2], Adel Elshafaei Ali[2]

[1] Nutrition Department, High Institute of Public Health, Alexandria University, Egypt.
[2] Dermatology and Andrology Department, Faculty of Medicine, Alexandria University, Egypt.
Dalia Ibrahim Tayel: Lecturer of Nutrition, High Institute of Public Health, Alexandria University, 165- EL-Horreya Avenue, EL-Hadrah, Alexandria, Egypt. E-mail: dalia2tayel@yahoo.com.

ABSTRACT

Acne is one of the most prevalent skin conditions affecting the majority of teenagers; the aim of the study was to alleviate acne severity by dietary intervention. Intervention study was performed on 40 acne cases aged 15-20 years. All participants were asked to follow a low glycemic load diet (LGL) for 12 weeks. Acne severity was assessed by global acne grading system (GAGS). Fasting blood glucose (FBS), serum insulin, insulin like growth factor-1 (IGF-1) and homeostasis model assessment of insulin resistance (HOMA-IR) and anthropometrics (weight and height) were measured at baseline and after dietary intervention. There was a significant decreasing in mean score of GAGS after LDL diet intervention (25.43±3.61 before and 16.35± 2.50 after; P= 0.026). Mean weight and BMI decreased not significantly (P>0.05); all of FBS, serum insulin, IGF-1 and HOMA-IR decreased significantly (P<0.05); and a direct significant correlation between GAGS score and all studied biochemical measurements was found after dietary intervention. The LGL diet plays a dual role in the prevention of hyperinsulinemia by lowering the postprandial insulin demand and improving insulin sensitivity which represents a dietary strategy to alleviate acne. Therefore, diet is believed to be one of the aetio-pathological factors of acne and following a LGL diet may have a therapeutic effect on acne. A nutritionist is required to educate acne patients how to follow a LGL diet during and after treatment of acne.

Key words: Therapeutic diet for Acne, low glycemic load diet, insulin sensitivity, insulin like growth factor-1, global acne grading system.

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INTRODUCTION

Acne is a chronic inflammatory disease of the pilosebaceous unit, characterized by formation of comedones, erythematous papules and pustules, less frequently nodules or cysts and in some cases scarring.[1] Acne is an easily treated cause of disfigurement and psychological morbidity.[2] Acne is one of the most prevalent skin conditions, affecting more than 85% of teenagers. It typically starts at puberty and resolves slowly as the person reaches 20, although some people continue to have acne till 40 and 50 years. Men and women develop acne equally.[3] Young men are more likely than young women to have more severe, longer lasting forms of acne. Young women are more likely to have intermittent acne due to hormonal changes associated with their menstrual cycle and acne caused by cosmetics.[2]

Pathogenesis of acne and the role of diet were uniformly noted among acne patients from different societies and cultures.[4,5] Although familial and ethnic factors are implicated in acne prevalence, this observation is complicated by the finding that incidence of acne has increased with the adoption of western lifestyles. Epidemiological observations point to a role of western diet in the development or aggravation of acne. Western dietary pattern is a dietary habit chosen by many people in developed countries and increasingly in developing countries. It is characterized by high intakes of red meat, sugary desserts, high-fat foods, and refined grains. It also typically contains high-fat dairy products, high-sugar drinks, and higher intakes of processed meat.[6] No case of acne has been detected in non westernized populations.[7] A low glycemic load (LGL) diet that mimics the diets of acne-free populations alleviate acne symptoms and hormonal markers of acne.[8]

The glycemic index (GI) is based on the glycemic response to a fixed amount of carbohydrate. GI is an indicator of the quality of dietary carbohydrate. The glycemic load (GL) is defined as the product of the available total carbohydrate content of a food item in grams and the corresponding GI of that food, divided by 100. Thus, GL represents both quality and quantity of dietary carbohydrate. Foods with a high GL elicit greater glycemic and insulinemic responses.[9] Diets high in GI are associated with greater fluctuations in blood glucose and insulin concentrations compared to those diets low in GI. Low-GI foods are usually defined as having a GI less than 55, moderate as GI 55 to 70, and high as G I more than 70.[10] A GL of 20 or more is high, a GL of 11 to 19 inclusive is medium, and a GL of 10 or less is low.[10]

High-GI carbohydrates are rapidly digested, producing rapid elevations in blood glucose and increasing insulin demand, in contrast, low-GI carbohydrates are slowly digested

and absorbed, and they elicit a low insulin response during the postprandial period.[9] Diets rich in carbohydrates with a high GI are associated with increased formation of insulin like growth factor-1 (IGF-1), while diets with LGL decreased serum IGF-1 levels and significantly improved acne, suggesting that LGL diet reduces free IGF-1 activity and bioavailability.[8,11] Higher serum androgen,[12] insulin, and IGF-1[5] concentrations are associated with the presence of acne. Taken together, the endocrine cascade induced by hyperinsulinemia enhances sebum synthesis and acne development.[13]

Expression of acne during adolescence may also be affected by endocrine changes, which are closely related to changes in insulin sensitivity. During normal puberty and adolescence, there is a transient decline in insulin sensitivity. According to cross-sectional observations, acne begins about the same time as the gradual increase in plasma insulin, the increase in IGF-I concentrations,[14] and the preadolescent increase in body mass index (BMI).[15] Acne incidence more closely corresponds to the changing course of insulin and IGF-I levels than to changes in plasma androgens. This is because insulin and IGF-I levels peak during late puberty and gradually decline until the third decade.[14]

Hyperinsulinemia may provide an important link between nutrition-related lifestyle factors and the incidence of acne. Accumulating evidence suggests that LGL diets may play a dual role in the prevention of hyperinsulinemia by lowering the postprandial insulin demand and improving insulin sensitivity [9,16] which represents a unique dietary strategy to alleviate acne.[17] So this study aimed to alleviate acne severity by the effect of LGL diet on pathogenesis of acne through the improvement of insulin sensitivity.

SUBJECTS AND METHODS

Intervention study was performed on 40 acne cases aged 15-20 years from outpatient Dermatology Clinic of Alexandria Main University Hospital, Egypt, from January to April 2012. Each participant at the baseline of the study was control for him/her-self compared to the end of the study after dietary intervention.

Endocrinal disturbances (as diabetes) or use of medications affecting glucose metabolism (e.g corticosteroids, some antihypertensives or oral hypoglycemic as metformin) were excluded from the study. Washout period of 6 months after oral retinoids and 2 months after oral antibiotics or topical antibacterial were also excluded from this study.

At baseline, acne severity was assessed by global acne grading system (GAGS) and blood samples were obtained for biochemical measurements. The participants were asked to follow a LGL diet for a period of 12 weeks. After 12 weeks of dietary intervention repeated

blood samples for biochemical measurements were collected and acne symptoms were re-assessed. Weight and height were measured 2 times at baseline and 12th week of LGL diet.

Global acne grading system (GAGS):

As regards type of lesions, their number and distribution; the severity of the disease was assessed by GAGS in every patient. This system divides the face, chest, and back into six areas as shown in Table (1). Forehead, each cheek, nose, chin, and chest and back and assigns a factor of 1, 2, or 3 to each area based on size. Each type of lesion is given a value depending on severity as follows: no lesions = 0, comedones = 1, papules = 2, pustules = 3 and nodules = 4. The score for each area (local score) is the product of the most severe lesion, multiplied by the area factor. These individual scores are then added to obtain the total score (global score). Global score equals the sum of local scores. A score of 1–18 is considered mild; 19–30 is moderate; 31–38 is severe; and ≥39 is very severe[18].

Table (1) The Global Acne Grading System (GAGS)[18]

Location	Factor
Forehead	**2**
Right cheek	**2**
Left cheek	**2**
Nose	**1**
Chin	**1**
Chest and upper back	**3**

Dietary intervention:

The LGL diet was designed to meet the individualized actual daily energy intake of each participant that matched with their baseline diet then provided weekly for every one for 12 weeks. For each participant at baseline, 24 hours recall method[19] was used to assess the dietary intake and Egyptian Food Composition Tables of National Nutrition Institute[20] were used to analyze this dietary intake and determine the actual daily energy intake. The foods provided in the LDL dietary regimen were typical of their normal diet taking into consideration the socioeconomic status of the participants. Dietary compliance was monitored by regular weekly interviews and telephone interviews.

The LGL diet was achieved through modifying the amount and type of carbohydrate and through substitution of high GL foods as (refined-grain bread, rice, or potatoes) with low GL foods as (whole grain bread, legumes, and vegetables).[10,21] The recommended LGL diet consisted of 52-54% of total energy from low GL carbohydrates, 18-20% from proteins and 26-29% from fats. Different caloric levels were pre-designed using Exchange System for Meal Planning of American Dietetic Associations[22] to meet approximately all levels of energy requirements for the participants of the study as shown in Table (2).

Table (2) Meal Plans for Different Caloric Levels Using Servings of Food Groups

Food group	*1000 kcal*	*1200 kcal*	*1400 kcal*	*1600 kcal*	*1800 kcal*	*2000 kcal*	*2200 kcal*
Starches/beans	5	6	7	8	9	10	11
Fruits	2	2	3	3	3	4	4
Milk (low)	2	2	2	2	3	3	3
Vegetables	2	3	4	5	5	5	5
Meat (medium)	2	3	3	4	4	4	5
Fat	2	2	3	3	3	4	5

CHO (52-54%), Protein (18-20%), Fat (26-29%)

Breakfast choices were such as broad beans, low fat white cheese, boiled eggs, or low fat tuna with whole-grain bread or whole-grain toast, bran or oat cornflakes with skimmed milk, whole-grain biscuits (with artificial sweetener) with skimmed milk, or low fat yoghurt.

Lunch choices were such as fresh vegetables salad or non-starchy vegetables (as spinach or okra); and grilled meat, chicken or fish; with brown or basmati rice or whole wheat bread.

Dinner choices were such as bran cornflakes with skimmed milk, or whole-grain biscuits (with artificial sweetener) with skimmed milk, or low fat yoghurt. Whole wheat bread and broad beans, low fat white cheese, boiled eggs were also choices for dinner. Snacks between the meals were whole fruits with low GL.[10,21]

Anthropometric measurements:

During the study period (12 weeks), anthropometric measurements included weight and height were measured 2 times; at baseline and 12th week in light clothing and without shoes following the method of Gibson.[23] Body mass index (BMI) was calculated as follows: weight (kg)/height^2 (m^2).

Biochemical measurements:

A baseline and 12th week code-labeled serum samples were collected from each participant and stored at -18 °C for analysis after the study by an independent laboratory. The samples were included in the same assay run to avoid variability of assay. Serum insulin was measured by solid-phase, 2-site chemiluminescent immunometric assay (Immulite/immuliter 1000 insulin; Diagnostic Products Corporation, Los Angeles, USA) with the use of an Immulite 1000 analyzer (Diagnostic Products Corporation, Los Angeles, USA). Fasting blood glucose (FBS) was measured on the day of testing with a Trinder reaction which based on reading the absorbance of a red quinoneimine dye proportional at 500 nm using spectrophotometer to detect the concentration of glucose in the sample (Linear Chemicals S.L. Glucose MR enzymatic colorimetric method). The homeostasis model assessment of insulin resistance (HOMA-IR), which is considered as insulin resistance index, was calculated as: fasting glucose (mmol/L) × insulin (μU/mL)/22.5.[24] HOMA-IR levels above 3 were accepted as indicators of insulin resistance. Insulin like growth factor-1 (IGF-1) was measured by a commercially available chemiluminescent immunometric assay (Immulite/immuliter 1000 IGF-I (PILKGF-8, 2005-02-23); Diagnostic Products Corporation, Los Angeles, USA).

Statistical Analysis

Statistical analysis was done using the Statistical Package for Social Science (SPSS) version "17" software (Chicago, Illinois, US). Data was presented tabular, graphically and mathematically using the mean and standard deviation (SD). For all analysis *P* value < 0.05 was used to detect statistically significant difference. Data were analyzed using Chi squared test for analysis of categorical data; Paired "t" test to compare the means of two independent groups; and Pearson's correlation to verify significant associations between the different variables.

Ethical considerations:

This study was conducted according to the guidelines laid down for medical research involving human subjects and was approved by ethics committees of High Institute of Public Health and Faculty of Medicine, Alexandria University, Egypt. All measurements were taken following all privacy procedures and all collected data were kept confidential. After informing the participants with the aim of the study, written consent was taken from every one. There are no conflicts of interest. This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

RESULTS

A total of 40 acne cases, 15 acne cases of mild degree of severity (37.5%) and 25 cases of moderates degree (62.5%) were detected at baseline as shown in Table (3). While after 12 weeks dietary intervention, 11 cases were transferred to be mild and became 26 cases (65.0%), consequently the moderate degree was detected in 14 cases only (35.0%). There is a statistically significant decreasing in the means score of GAGS before and after LDL diet intervention (25.43±3.61 and 16.35± 2.50, respectively; *P*= 0.026). Figure (1) shows examples of cases with moderate degree (cases A,C and E) and the same cases after 12 weeks of LDL diet intervention that became mild (B,D and F).

Table (3) Grading of acne patients according to GAGS at baseline and after 12 weeks of dietary intervention (n=40)

GAGS	Baseline No. (%)	After LDL diet No. (%)
Mild	15 (37.5)	26 (65.0)
Moderate	25 (62.5)	14 (35.0)
Score (Mean ± SD)	25.43 ± 3.61	16.35 ± 2.50
	P*= 0.026	

***P*<0.05**

Figure (1) Photographs showing acne improvement among cases at baseline (A, C and E) and the same cases after 12 weeks of LDL diet intervention (B, D and F)

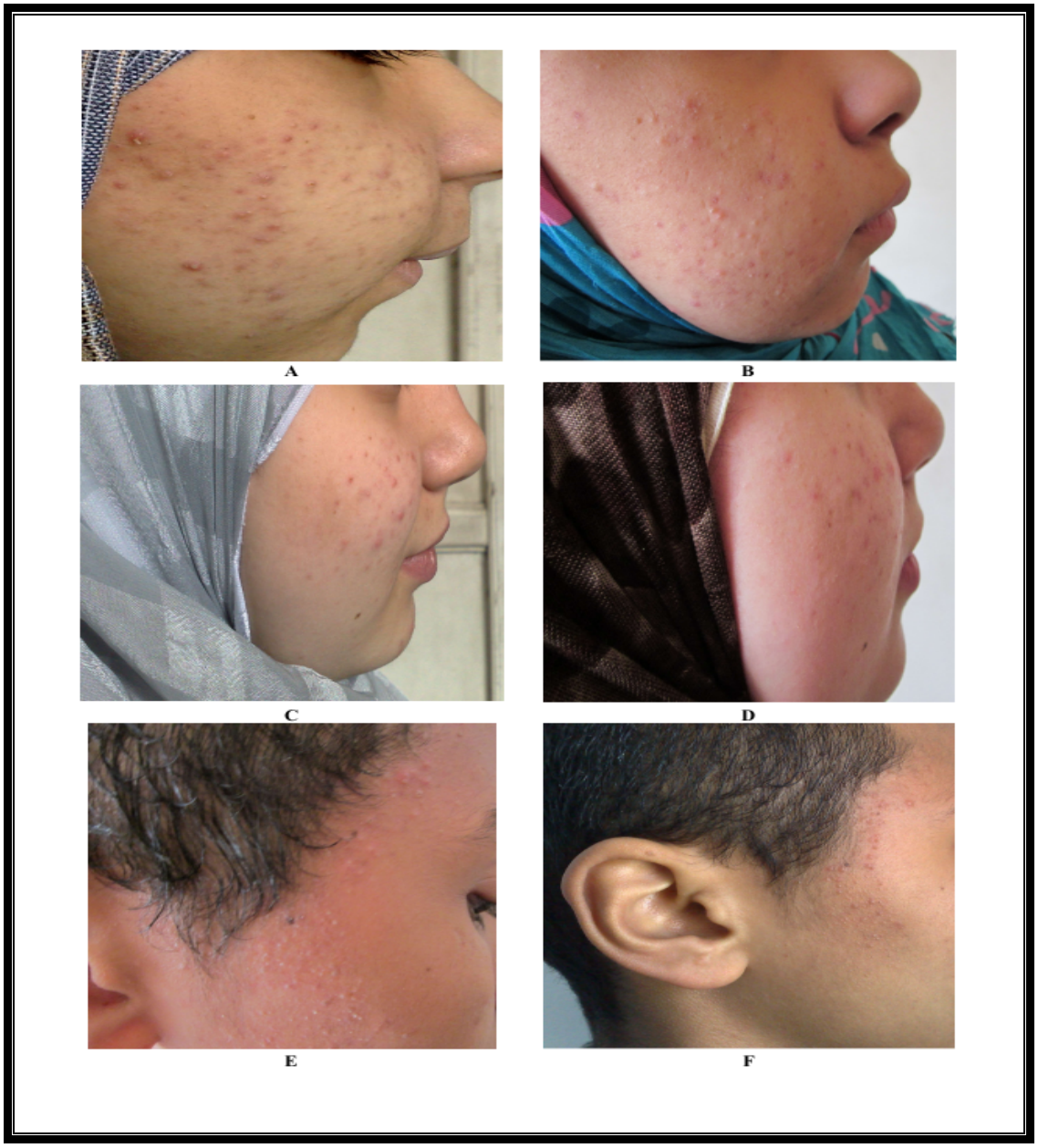

Table (4) illustrates anthropometric and biochemical measurements at baseline and after 12 weeks of dietary intervention with LDL diet. Demonstrating that the weight with the mean of 70.35 ± 8.51 kg at baseline and mean height was 162.50 ± 1.87 cm, the mean BMI was 26.65 ± 3.31 kg/m^2 at baseline. After 12 weeks of dietary intervention, the mean weight and BMI decreased to be 69.20 ± 8.19 kg and 26.22 ± 3.20 kg/m^2, respectively with no statistically significant difference.

The results of Table (4) also revealed that at baseline the biochemical measurements were FBS with the mean of 96.70 ± 6.40 mg/dl, mean serum insulin was 15.10 ± 0.54 µU/ml, mean IGF-1 was 170.40 ± 12.58 ng, and mean HOMA-IR was 3.44 ± 0.32. On the other hand, after 12 weeks of LDL dietary intervention all biochemical measurements decreased significantly (P<0.05).

Table (4) Anthropometric and biochemical measurements before and after 12 weeks dietary intervention (n=40)

Measurements	Baseline Mean ± SD	After LDL diet Mean ± SD	*P* value
Weight (kg)	70.35 ± 8.51	69.20 ± 8.19	0.540
BMI (kg/m^2)	26.65±3.31	26.22±3.20	0.560
FBS (mg/dl)	96.70±6.40	73.66±2.60	0.000*
Serum insulin (µU/ml)	15.10±0.54	3.60±1.39	0.000*
IGF-1 (ng)	170.40±12.58	164.03±20.88	0.048*
HOMA-IR	3.44±0.32	0.72±0.20	0.000*

***P*<0.05**

Table (5) shows the correlation between acne grading score (GAGS) and the biochemical measurements after LDL dietary intervention. A direct significant correlation was found between GAGS score and all studied biochemical measurements.

Table (5) Correlation between grading of acne and IGF-1, serum insulin and insulin sensitivity after LDL dietary intervention

	r	*P* value
GAGS score	**Dependent**	
IGF-1	0.39(*)	0.003
Serum insulin	0.42(*)	0.001
HOMA-IR	0.21(*)	0.032

***P*<0.05**

DISCUSSION

Acne vulgaris is a prevalent skin disorder with substantial physical and psychological morbidity.[2] Although familial and ethnic factors are implicated in acne prevalence, this observation is complicated by the finding that incidence rates of acne have increased with the adoption of western lifestyles. These observations suggest that lifestyle factors, including diet, may be involved in acne pathogenesis.[8,9] There has been a reappraisal of the diet and acne connection because of a greater understanding of how diet may affect endocrine factors involved in acne. Insulin resistance and dietary carbohydrates have recently been implicated in the etiology of acne.[8,17,25] GI of meals has been directly correlated to insulin response and low GI diets have been shown to decrease insulin resistance.[16] High insulin concentrations in the fasting and/or postprandial state may exacerbate acne by increasing the proliferation of basal keratinocytes. Insulin also stimulates the synthesis of androgens leading to high sebum production, a recognized correlate of acne severity. Insulin resistance could also increase inflammatory responses within and adjacent to the comedo.[26]

In the present study, there was a significant improvement in acne grading (according to GAGS) in patients after 12 weeks of LDL dietary intervention. This is consistent with the study was done on people living in Kitavan Island, Papua New Guinea and the Ache Indians of Paraguay who don't suffer from acne and this is associated with their LDL diet.[8] This also goes with other studies on acne patients that followed LDL diet demonstrated significant clinical improvement in acne with overall reduction in total counting of lesions and inflammatory acne lesions.[11,31] Also histopathological examination of skin samples revealed several characteristics including reduced size of sebaceous glands and decreased inflammation.[27]

In contrast, the study done on facial acne severity which was assessed by examining the number and degree of inflammation of inflammatory lesions (papules, pustules and nodules not comedones or scars) on the face, acne was graded on a scale from 0 to 3 (0: no acne, 1: mild, 2: moderate and 3: severe). No effect of glycemic index was found on facial acne severity over 8 weeks. Short study duration and the 4-point acne grading method which was novel and not internationally validated and capable of detecting only relatively large changes in the severity of inflammatory lesions are limitations of this study.[28]

High glycemic load diet may be a significant contributor to high prevalence of acne seen in western countries. The frequent consumption of carbohydrates of high glycemic index exposes adolescents to acute hyperinsulinemia which influences follicular epithelial growth, keratinization and sebaceous secretion. Therefore a LDL diet may have a therapeutic effect on

acne related to the beneficial endocrine consequences of these diets that may influence the development of acne through androgen, IGF-1, IGF binding proteins (IGFBP).[8,25,29]

Postprandial insulin responses may be of particular relevance during puberty and adolescence when whole body insulin resistance naturally increases.[29] Insulin resistance is characterized by decreased cellular uptake of glucose and higher than normal insulin levels are required for adequate glucose uptake. Similarly, compensatory hyperinsulinemia is associated with higher cellular concentrations of free insulin-like growth factor-1. Indeed, the highest incidence of acne occurs when IGF-1 levels peak. Interventions that reduce fasting and postprandial insulinemia and IGF-1 concentrations would therefore be expected to decrease sebum production and keratinocyte proliferation.[30,.31]

In the present study, there was significant reduction in levels of serum insulin, FBS, IGF-1 and HOMA-IR after the LDL dietary intervention compared to their levels before the intervention (table 2). This reflects the beneficial endocrine effects of LGL diet and its effect on acne, also reflects the improvement in insulin sensitivity in relation to improvement in acne. The significant direct correlations that were found between acne grading and IGF-1, serum insulin and HOMA-IR after 12 weeks of LDL dietary intervention (table 5) ascertain the improvement of insulin sensitivity which represents a dietary strategy to alleviate acne. These findings are in accordance with other studies that indicate a significant difference in FBS, serum insulin and HOMA-IR values showing a positive effect of a LGL diet on insulin sensitivity.[8,11,32]

Since normal sebaceous gland growth is influenced by factors other than androgens such as IGF-1, therefore increased expression of IGF-1 or a reduction in the level of its carrier protein should influence acne. IGFBP-1 levels increased significantly in the LGL group compared with control group. Therefore it is possible that LGL diet may be also induce changes to the IGF system that may be clinically relevant to events involved in acne pathogenesis.[8]

Regarding the anthropometric measurements of patients in this study after 12 week of LGL diet plan, there was no significant difference in weight or BMI because the diet was planned to maintain baseline energy intake of every patient according to assessed collected energy intake using 24hr recall (a method of dietary intake assessment). The diet composed of 52-54% of total energy from low GL carbohydrates, 18-20% from proteins and 26-29% from fats. High protein diet was not used to avoid the health hazards that caused by excessive protein intake such as a higher risk of kidney stone formation from calcium in the renal system, gout, osteoporosis and dehydration.[33] This goes with the studies revealed that no

significant changes in BMI and weight after LDL dietary intervention. However there was a significant change in body composition. [27,34]

In contrast, in the studies,[8,11] the participants in the LGL group lost weight despite receiving dietary advice to maintain their baseline energy intake. This may have been due to the dual effect of added protein and low-GI foods, because both influence hunger and satiety. Feeding studies have shown that low-GI foods increase satiety, delay hunger, and decrease food intake when compared with high-GI foods.[35-37] Similar effects on satiety have been reported for high-protein meals compared with isocaloric high-carbohydrate or high-fat meals.[38] Therefore, the combined effect of low-GI foods and added protein may have reduced food intake, which made it difficult for participants to maintain the energy density of their baseline diets.

A few limitations of the study should be addressed because of the nature of the LGL dietary intervention. The treatment effects cannot be solely attributed to changes in glycemic load because other dietary factors (e.g. zinc and vitamin A intake) and dairy products may mediate or confound the relation between diet and acne improvement. Also emotional stress, physiologic and physical factors may affect the pathogenesis of acne.

CONCLUSION AND RECOMMENDATIONS

A LGL diet was shown reduction in acne severity and insulin sensitivity after 12 weeks. Means of GAGS score, FBS, serum insulin, IGF-1 and HOMA-IR decreased significantly after LDL diet intervention. Mean weight and BMI decreased not significantly. A direct significant correlation between GAGS score and all studied biochemical measurements was found after dietary intervention.

The results of this study open the prospect that nutrition-related lifestyle factors may affect the pathogenesis of acne. Therefore, these results should be considered preliminary, and larger-scale studies are needed to confirm the effect of dietary intervention on acne. A nutritionist is required to educate acne patients how to follow a LGL diet during and after treatment of acne. Further researches are needed to study the changes in body composition using bioelectrical impedance method after LGL among acne patients.

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