Original Article

Effects of Low Carbohydrate Diet on Obesity

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ABSTRACT

Objective : Lifestyle factors, including nutrition, play an important role in the etiology of Cardiovascular Disease (CVD). This position paper, written by IAS fitness team highlights the effects of Low Carbohydrate Diet (LCD) on body fat percent (%).

Method : We studied the effect of dietary modification in 98 obese patients over 24 weeks. Obesity was defined as per body fat percentage. Both borderline obese & obese patients were included. Baseline height, weight, body mass index, body fat percent & other demographic data was collected. Routine blood tests like complete blood count, Kidney function tests, Random blood sugar, Total lipid profile were performed at baseline. Low carbohydrate structured diet was prescribed to all patients & were reviewed at the end of 6 months. At 6 months, height, weight, body mass index & body fat percent were recorded. Data was entered in excel sheet. Paired Student's t test was used for statistical analysis with the help of Graphpad software (online version).

Results : Mean body weight at baseline was 92.54 + 17.12 kg. It reduced to 78.53 + 13.68 kg at the end of 6 months. (p<0.0001). Mean BMI at baseline was 32.74 + 5.45 kg/m2. It was reduced to 27.83 + 4.61 kg/m2 at the end of 6 months (p<0.0001). Mean percent of body fat at baseline was 36.58 + 5.61 % which was reduced to 28.01 + 5.61 % at the end of 6 months (p<0.0001).

Conclusion : Our study shows that structured low carbohydrate diet significantly helps in reducing body fat percent, weight & body mass index in borderline obese & obese patients. Authors suggests that body fat percent should be used to define obesity as against BMI.

Keywords : Low Carbohydrate Diet, Body fat percent, Body mass index, Weight, Obesity.

Introduction :

Lifestyle factors, including nutrition, play an important role in the etiology of Cardiovascular Disease (CVD).

Obesity represents a state of excess storage of body fat. Normal, healthy men have a body fat percentage of 15-20%, while normal, healthy women have a percentage of approximately 25-30%.[1]

The body mass index (BMI), also known as the Quetelet index, is used far more commonly than body fat percentage to define obesity. An individual's BMI is calculated as weight/height[2], with weight being in kilograms and height being in meters. In general, BMI correlates closely with the degree of body fat in most settings; however, this correlation is weaker at low BMIs.

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Although the BMI typically correlates closely with percentage body fat in a curvilinear fashion, some important caveats apply to its interpretation. In mesomorphic (muscular) persons, BMIs that usually indicate overweight or mild obesity may be spurious, whereas in some persons with sarcopenia (eg, elderly individuals and persons of Asian descent, particularly from South Asia), a typically normal BMI may conceal underlying excess adiposity characterized by an increased percentage of fat mass and reduced muscle mass. In view of these limitations, some authorities advocate a definition of obesity based on percentage of body fat. For men, a percentage of body fat greater than 25% defines obesity, with 21-25% being borderline. For women, over 33% defines obesity, with 31-33% being borderline.[2]

A person's body fat percentage can be indirectly estimated by using the Deurenberg equation (body fat percentage = 1.2 (BMI) + 0.23 (age) - 10.8 (sex) - 5.4, where age value is entered in years and sex being designated as 1 for males and 0 for females).

This equation has a standard error of 4% and accounts for approximately 80% of the variation in body fat.

So to overcome the shortcomings of BMI in our population, we have selected body fat percentage as a criteria to select cases of borderline and overt obese patients.

Material & Method :

We retrospectively analyzed the diet sheets and health progress card of these patients. All subjects completed a comprehensive medical examination and routine blood tests which included complete blood count, renal function test, total lipid profile & random blood sugar. Exclusion criteria were history of clinically significant illness, pregnancy or lactation or history of medications that affects body weight. Study was approved by the ethics committee. A total of 98 persons (45 men and 43 women) were included in the study.

Obesity was defined as per body fat percent criteria. For men, a percentage of body fat greater than 25% was used to define obesity & those between 21-25% as borderline obesity. Similarly for women, a percentage of body fat greater than 33% was used to define obesity & those between 31-33% as borderline obesity.

The study time period was January 2018 to October 2018. At the baseline and 24 weeks, weight, BMI and body fat % were recorded Body fat percent was recorded by Karada scan body composition monitor HBF 375 manufactured by OMRON HEALTHCARE SINGAPORE PTE LTD. Weight was measured on electronic weighing machine & BMI was calculated on calculator.

All were advised low carbohydrate diet (structured to suit individual goals) by qualified dietary advisers.

Structured diet involved limiting carbohydrate intake and restricting consumption of fat and protein according to calorie requirements of individuals who were kept approximately 20% calories deficit according to their weight and their daily activities. Diet was structured so that it included proteins at 1.2 to 1.8 gram per kg body weight, fat at 0.4 to 1 gram per kg body weight & carbohydrates at 0.5 to 1.5 grams per kg body weight. Accordingly, each subject was given a copy of diet chart & subjects were instructed to follow the diet as described.

Statistical Analysis :

Mean and standard deviation were calculated for body weight, BMI and percentage body fat loss at the baseline and at 24 weeks. Both mean absolute and relative reduction were measured in all parameters. Paired Student's t-test was used to evaluate effect of LCD on these parameters. Graphpad software (online version) was used for the statistical analysis.

Results :

Weight : The subjects had lost significant weight by 15%. Mean body weight at baseline was 92.54 + 17.12 kg which was reduced to 78.53 + 13.68 kg at the end of 6 months. ($p < 0.0001$, mean reduction : 13.87 + 7.1 kg, relative reduction : 15%)

BMI : The subjects had lost significant BMI. Mean BMI at baseline was 32.74 + 5.45 kg/m2 which was reduced to 27.83 + 4.61 kg/m2 at the end of the study. ($p < 0.0001$, mean reduction: 4.83 + 2.3 kg/m2, relative reduction : 14.8%).

Body percent fat loss : The subjects had lost significant body fat percentage. Mean % of body fat at baseline was 36.58 + 5.61 % which was reduced to 28.01 + 5.61 % at the end of the study. ($p < 0.0001$, Mean reduction : 8.49 + 3.15 %, relative reduction : 23.2%).

Table 1 : **Effect of LCD on different parameters (Values are presented as mean + SD)**

	Baseline	24 weeks	Difference	Relative reduction (%)	P-value*
Body weight (kg)	92.54 + 17.12	78.53 + 13.68	13.87 + 7.1	15	<0.0001
BMI (Kg/m2)	32.74 + 5.45	27.83 + 4.61	4.83 + 2.3	14.8	<0.0001
Body Fat (%)	36.58 + 5.61	28.01 + 5.61	8.49 + 3.15	23.2	<0.0001

Discussion :

Even as India battles malnutrition, the country has developed another nutritional problemobesity.[3]

Obesity is a disease associated with a significant increase in mortality and many health risks, including type 2 diabetes mellitus, hypertension, dyslipidemia, and coronary heart disease. The higher the body mass index (BMI), the greater the risk of morbidity and mortality.[4]

The various dietary patterns include low carbohydrate diet, low-fat diet, Mediterranean diet, and the DASH diet.

The low fat diet is based on total fat consumption of 25%-35% of total calories, of which, saturated fat (SFA) should be no more than 7%-10%, trans fat (TFA) less than 1%, unsaturated fats, mainly monounsaturated fats (MUFA) and omega-3 polyunsaturated fat (n-3 PUFA) should represent the rest of the calories from fat and cholesterol, for a total of less than 300 mg/day.[5]

These recommendations can be achieved by choosing low-fat meats and emphasizing vegetables, low-fat dairy products and 1% milk, and lowering food containing TFA.[6] Generally, this diet increases the carbohydrate intake, and controversy remains about the type and amount of carbohydrate consumed.[7] A low-carbohydrate diet is defined as consumption of 30-130 g of carbohydrate per day or up to 45% of total calories.[8]

The most recent systematic[9] review and meta-analysis among 1141 obese patients, showed the low-carbohydrate diets to be associated with significant decreases in body weight [-7.04 kg (95% CI -7.20/-6.88)], body mass index (BMI) (-2.09 kg/m2) (95% CI -2.15/-2.04), systolic blood pressure [-4.81 mmHg (95% CI -5.33/-4.29)], diastolic blood pressure [-3.10 mmHg (95% CI -3.45/-2.74)], plasma TG [-29.71 mg/dL (95% CI -31.99/-27.44)], as well as an increase in HDL-C (1.73 mg/dL) [95% CI 1.44/2.01]. The authors concluded that low-carbohydrate diets result in favorable effects on body weight and major CV risk factors; however, the effects on long-term health are unknown.

A two-year Dietary Intervention Randomized Controlled (DIRECT) trial among 322 moderately obese participants that compared low-fat, Mediterranean, and low-carbohydrate diets found that compared to the other diets, the low-carbohydrate diet was most effective in weight loss, decreasing TG and increasing HDL-C levels.[10] However, at follow-up four years after completion of the randomized study, the weight regain in the low-carbohydrate group was also most prominent, resulting in similar overall weight loss between the low-fat and low-carbohydrate groups.

Despite this partial weight regain, there was a reduction in the ratio of LDL-C to HDL-C (a reduction of 0.16, p = 0.04), and the reduction in TG levels (11.3 mg/dL, p = 0.02) remained significant in the low-carbohydrate group, suggesting a long-lasting, favorable post-intervention effect.

In our study also there was significant reduction in obesity parameters in obese individuals on LCD. The subjects on the low-carbohydrate diet (structured diet) had lost significant weight by 15%. Mean body weight at baseline was 92.54 + 17.12 kg which was reduced to 78.53 + 13.68 kg at the end of the study. (p<0.0001, mean reduction : 13.87 + 7.1 kg, relative reduction : 15%). The subjects on the low-carbohydrate diet had lost significant BMI. Mean BMI at baseline was 32.74 + 5.45 kg/m2 which was reduced to 27.83 + 4.61 kg/m2 at the end of the study. (mean reduction : 4.83 + 2.3 kg/m2, relative reduction : 14.8%). The subjects on the low-carbohydrate diet had lost significant body fat percentage. (Mean % of body fat at baseline was 36.58 + 5.61 % which was reduced to 28.01 + 5.61 % at the end of the study. (p<0.0001, Mean reduction : 8.49 + 3.15 %, relative reduction : 23.2%).

We stressed upon individual food likings & disliking and accordingly dietary chart was given which improved compliance. It was made sure that structured diet was sufficient to provide daily recommended levels of essential micronutrients & vitamins.

The Mediterranean diet was originally described in Crete and Italy, and is characterized by a relatively high fat intake (40%-50% of total daily calories), of

which SFA comprises =8% and MUFA 15%25% of calories.[11]

The DASH diet comprises vegetables and fruits, as well as low-fat dairy products, whole grains, chicken, fish, and nuts. On the other hand it is low in fat, meat, sweets, and sodas. The DASH diet provides more calcium, potassium, magnesium, and dietary fiber and less fat, SFA, cholesterol, and sodium than the typical western diet.[12]

In our study, we found that if only quetelets index was used to define obesity, we would have missed 4 persons which were defined obese as per body fat percentage criteria as discussed above. Authors suggest to use body fat percent for defining obesity & also recommends to follow reduction in body fat percentage to look for response after dietary intervention.

Conclusion :

Authors recommend the structured diet for all the individuals depending on their body requirements and desired goals as one size doesn't fit to all. In our study, we found that low carbohydrate diet was useful in weight reduction, improved body mass index & also body fat percentage. Authors stress upon the need of use of body fat percentage criteria to define obesity & monitor weight loss.

Limitation :

1. Our study has small sample size and is for short duration of 24 wks, we recommend a large randomized control trial to assess the effects of LCD on obesity for longer duration.

2. Metabolic parameters were not assessed in our study which should ideally be checked upon in individuals on LCD.

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