

# Low carbohydrate diet

## Its effects on selected body parameters of obese patients

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### ABSTRACT

**Objectives:** This pilot study, which involved 13 obese patients, was conducted to determine the effect of a low carbohydrate diet on the body weight and other body parameters, including blood pressure and selected biochemistry indicators.

**Methods:** The study was carried out in Naim Health Center, Bahrain during the period March 2002 to April 2002. Each individual was followed for 6 weeks while on a low carbohydrate diet, with careful monitoring during the study period.

**Results:** Paired t-test showed statistically significant reduction of waist circumference ( $p < 0.00$ ) and body weight ( $p < 0.00$ ) of the sample population after 6 weeks from the

commencement of the diet. The body mass index also showed statistically significant reduction during the study period ( $p < 0.01$ ). Furthermore, blood cholesterol level was reduced ( $p < 0.012$ ). Although there was a statistically significant decrease in the fasting blood sugar levels ( $p < 0.01$ ), the mean readings remained within the normal range of blood sugar levels. There were no statistically significant changes in the levels of urate, creatinine, urea, triglyceride, and in systolic or diastolic blood pressure readings ( $p > 0.05$ ).

**Conclusion:** Low carbohydrate diet could help in reducing body weight without any significant harmful effect.

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Obesity is a condition in which there is excess body weight, an increase in the body mass index (BMI) and an undesirable excess of body fat accumulation.<sup>1</sup> The global preoccupation with weight control is increasing due to perceived social, psychological and economic rewards to be derived from a trim figure.<sup>2</sup> Nowadays many people are concerned with their body image and many follow various types of dietary regimen whether it is scientifically proven to be safe or is simply the latest fad reported in the media. It has been reported that each year the American people spend US\$33 billion on weight loss programs, products and pills.<sup>3</sup> Although

anyone on a diet would be able to lose some weight, maintaining the achieved new weight is the most difficult task. Therefore, it is important that individuals are educated on the futility of short-term dieting, and the need to develop a new lifestyle.<sup>4</sup> Many articles have been published regarding dieting and the type of food to be consumed during the dietary regimen. The high protein or low carbohydrate diet is one such modality that can help in losing body weight. However, it is neither new nor innovative, as it has been popular since the 1960's. More than a century ago, an English surgeon, William Harvey, devised a diet for obesity,

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which mainly avoided sweet and starchy foods while permitting meat.<sup>5</sup> This type of diet has been prescribed by physicians to diabetic patients for a long time but has not been applied as a basic principle in the management of obesity.<sup>6</sup> Although Atkins believes that a high protein diet (Atkins's diet) is a safe and effective way of reducing body weight, St Jeor et al<sup>7</sup> claimed that there has not been a long-term scientific study to support its overall efficiency and safety. The Atkins's diet remains a controversial issue with some supporting it<sup>5,8-10</sup> and others criticizing it,<sup>1,7,11,12</sup> of whom a few believe that it might have harmful effects.<sup>13</sup> Atkins believes that the consumption of sugar, which is the cause of obesity in middle age, has gone up from 4 pounds/person/year in 1750 to 20 pounds in 1850 and 170 pounds in 1970. Atkins claims that he treated 10,000 overweight patients, and all lost weight without counting calories, without using diet pills and most of all without the feeling of hunger. He believes that one could eat as much as he would desire as the ketonemia would diminish appetite thus leading to inhibition of food intake.<sup>14</sup> Ketogenesis resulting from such diets supposedly suppresses the appetite.<sup>15</sup> In 1956, Kekwick and Pawan<sup>6</sup> stated that obese patients on an extremely high fat diet of 1000 k-calories (90% of calories from fat) lost weight more rapidly over an 8-10 day period than when they were on a diet containing a similar proportion of carbohydrate. For the low carbohydrate diet, many modalities have been suggested.<sup>17</sup> Such as 1. Carbohydrate addicts lifespan program - it implies 2 daily meals that composed of high protein food with very little carbohydrate. A third meal includes high carbohydrate foods only if balanced with high protein foods. 2. Sugar buster - promoter believes that sugar causes extra weight and foods that surge insulin increase the likelihood that energy will be stored as fat. 3. The zone - every meal must constitute of 40% carbohydrate, 30% protein and 30% fat for maximum burn of energy. 4. Skillman's quick weight loss - it is a diet low in carbohydrate, and high in protein. The fat content varies depending on the chosen meat.<sup>8</sup> 5. Atkins new diet revolution.<sup>14</sup>

Fish,<sup>6</sup> commenting on Atkins's diet, stated that on a daily diet consisting of 20-30% of carbohydrate for approximately 6 weeks, a person would be able to lose 30 pounds without being hungry.<sup>6</sup> An important reason for people to accept the low carbohydrate diet is that it does not require knowledge of the caloric value of food items. Since only carbohydrate is restricted, the patient could be instructed to eat as much as they like of foods such as meat, fish, eggs, cheese, butter, margarine, oil, cream, leafy vegetables and not think of caloric restriction.<sup>18-21</sup> This diet offers a quick and painless weight loss while allowing consumption of favorite or tasty foods, avoiding severe restrictions on certain other foods or food categories.<sup>22</sup>

**Methods.** This pilot study includes 13 obese individuals, comprised of 9 females and 4 males, who volunteered to participate and wanted help to reduce

their body weight. They were fully informed of the low carbohydrate diet and the study procedure. Information leaflets on this diet were distributed to them before implementing the study. The patients were informed that they would be followed up 3 times at 2 week intervals during a 6-week period. Their consent was taken to participate in the study. The sample participants were asked to maintain a diary of their dietary habits for the week before the implementation of the study. The supervising doctor carefully examined this diary. For all of them a complete medical check-up was carried out, especially kidney and liver function tests to ensure that there were no contraindications to this type of dieting. Every visit the following parameters were recorded: Anthropometric parameters, which included body weight, height (first visit), the calculated BMI, little finger obesity, and waist size; vital signs (blood pressure [BP] and pulse rate); and biochemistry indicators (fasting blood sugar, urea, creatinine, uric acid, cholesterol, triglyceride, and routine urine test). For each 2-week period of the study, the individuals were advised to maintain a special diet. In the first 2 weeks, the diet constituted mainly of protein (85%) and other categories of food (15%), including vegetables and fruits but not including sugar and carbohydrates. During the second 2 weeks, the diet was constituted of 75% protein, and the remaining 25% of other foodstuff, while the diet in the remaining 2 weeks contained 65% protein and 35% other. Calcium and multi-vitamin tablets were prescribed to be taken on a daily basis and all participants were advised to drink as much fluid as required (which mainly consisted of water to avoid any additional sugar or carbohydrate). They were also given written instructions and a question and answer information package regarding this diet. The individuals were advised to strictly adhere to the list of food items given to them and to contact the supervising physician in case of an emergency or for any query.

**Results.** The study group includes 4 males and 9 females. Their ages ranged between 26 and 52 years with a mean of 40.6 years (47.5 for males and 37.6 years for females). Individuals' various parameters at the 3 stages of the study are shown in **Table 1**. Data analysis revealed an overall reduction in the mean body weight of the participants from 88.2-82.8 kg in 6-week period. Paired t-test showed that the reduction was statistically significant ( $p < 0.000$ ), presented in **Table 2**. The mean BMI at the commencement of the study was 32.3 kg/m<sup>2</sup> (the mean for males was 31.3 kg/m<sup>2</sup> and for females 32.7 kg/m<sup>2</sup>). The computed mean BMI at the end of the study period was 30.1 kg/m<sup>2</sup> (27.9 kg/m<sup>2</sup> for males and 31.1 kg/m<sup>2</sup> for females). Paired t-test showed that the reduction in BMI during the study period was statistically significant ( $p < 0.01$ ). Waist measurement was reduced from an average of 105.2 cm to 98.8 cm, and was statistically significant ( $p < 0.000$ ). Cholesterol level was reduced from 5.1 mmol to 4.5 mmol in 6 weeks, and the decrease was statistically significant

( $p < 0.012$ ). Furthermore, the mean fasting blood glucose level for the sample was decreased from 5.9 mmol to 5.4 mmol, which was statistically significant ( $p < 0.014$ ). Statistically there were no significant changes in the measurements of urea, triglycerides, urates, and systolic and diastolic BP, nor were there any significant reduction in the little finger's obesometry.

**Discussion.** In high protein diets, the weight loss is initially high. This is due to fluid loss related to reduced carbohydrate intake, overall caloric restriction and ketosis induced appetite suppression.<sup>7</sup> Although both men and women can lose weight on a protein diet, we found, along with others, that men lose more weight initially than women. Moore<sup>23</sup> related this finding to a greater water loss by men, as they have more muscle mass and larger glycogen stores than women, which when depleted results in a larger fluid loss from the water bound to the glycogen. Another reason for a weight reduction in both sexes could be related to the reduction of total calorie intake by people who are on a low carbohydrate diet, which ranges from 13-55% and could also be due to the decreased appetite.<sup>24</sup> The body weight and the BMI were significantly reduced in our study and others.<sup>25-26</sup> The individuals involved in our study complained initially of fatigue, which disappeared in a few days. Others have also reported similar findings.<sup>27,28</sup> It has been stated that a high-protein low-or zero-carbohydrate diet might lead to fatigue, nausea and anorexia. Bloom and Azar,<sup>29</sup> in their study of subjects who were kept on a carbohydrate free diet stated that the subjects complained of fatigue after 2 days of the diet, and also complained of postural hypotension. Their average systolic BP decrease by 30 mm Hg, and diastolic by 15 mm Hg. The Canadian Army during World War II complained of fatigue, nausea, dehydration and anorexia, when emergency rations consisting entirely of dried beef and fat (30% protein

and 70% fat) was given to them.<sup>27,28</sup> In our study, a significant decrease in the serum cholesterol level of the studied population over a 6-week period of low carbohydrate diet was found. It is reported in the literature that a diet rich in cholesterol and saturated fats lowers the cholesterol in 70% of patients.<sup>16</sup> It has also been reported that a high fat diet may be more efficient than a high carbohydrate diet in its ability to deposit fat when more than the required amounts of calories are eaten. Fat can be used with 79-85% efficiency whereas carbohydrate will be utilized with 62-77% efficiency.<sup>30</sup> It has been suggested that if protein is given alone rather than mixed with carbohydrate, the insulin in the blood will be lowered. With a lower insulin level, there will be a less inhibition of lypolysis and release of more free fatty acids from adipose sites, and ketone bodies will be produced in the liver from excess free fatty acids. The beneficial effects of a low carbohydrate diet on blood lipids and insulin resistance diabetes<sup>25,26</sup> are due to the weight loss and not to the change in caloric composition.<sup>7</sup> High intake of vegetable protein from gluten may have beneficial effects on cardiovascular disease risk by reducing oxidized low-density lipoprotein, serum triacylglycerol and uric acid.<sup>31</sup>

For the individuals involved in this study calcium and multivitamin tablets were prescribed to be taken on a daily basis since it is known that ingestion of protein increases urinary calcium excretion, and could lead to a deficiency in calcium thiamine, riboflavin, folic acid and ascorbic acid.<sup>11</sup> Higher calcium intake offset the calciuric effects of protein. However, in 2 randomized controlled trial studies, it is reported that increased protein intake dramatically improved outcomes after hip fracture.<sup>32,33</sup> Our study, did not show any significant effect of low carbohydrate high protein diet on the level of uric acid. However, others have found that a ketogenic diet may cause an increase in the blood uric acid concentration and hyperuricemia.<sup>1</sup>

Table 1 - Mean of various parameters at the 3 stages of the study.

Parameters	At 2 weeks	At 4 weeks	At 6 weeks
Weight (kg)	88.21	85.23	82.84
BMI (kg/m <sup>2</sup> )	32.26	31.20	30.12
Obesometry (mmt)	7.65	8.85	9.81
Waist (cm)	105.20	102.35	98.85
Fasting blood sugar (mmol/L)	5.9	5.6	5.4
Urea (mmol/L)	4.9	5.2	4.8
Cholesterol (mmol/L)	5.1	4.9	4.5
Triglyceride (mmol/L)	1.3	1.2	1.1
Urate (μmol/L)	276.8	277.8	269.5
Creatinine (μmol/L)	76.1	78.7	76.2
Systolic BP (mm Hg)	199	121	120
Diastolic BP (mm Hg)	73	75	73

BMI - body mass index, BP - blood pressure

Table 2 - Paired sample tests.

Parameters	Paired differences					t-test	df	Sig (2-tailed)
	Mean	SD	SEM	95% CI				
				Lower	Upper			
WT1-WT3	5.369	2.531	0.702	3.840	6.899	7.649	12	0.000
W1-W3	6.346	2.940	0.815	4.570	8.123	7.784	12	0.000
FBG1-FBG3	0.523	0.837	0.232	0.017	1.029	2.254	12	0.044
C1-C3	0.608	0.738	0.205	0.162	1.053	2.970	12	0.012

WT - body weight, W - waist, FBG - fasting blood sugar, C - cholesterol, CI - confidence interval, df - degree of freedom, Sig - significant

The Food and Drug Association website, in seeking to help consumers understand nutrition and diet, provides the following warning for people who consider going on a fat diet:<sup>34</sup> no food or diet provides the magic answer to weight loss (it is all about habits); and eliminating food groups or not combining certain foods simply decreases variety and nutrition not weight. Buying special product supplements or formulas will only decrease the weight of your wallet and if it sounds too good to be true, it probably is. Nagy<sup>35</sup> thinks that for any weight-reducing regimen to be successful caloric intake must be decreased, or caloric output increased. Long-term weight loss depends on the consumption over a long period of time of less energy than is expended. The ideal approach is to increase physical activity while modifying eating behavior to achieve a nutritionally balanced intake.<sup>22</sup>

In conclusion, although the high protein diet helps in reducing body weight without any significant harmful effect, the fact should be stressed that no food or diet provides a magic answer. Good habits are the key. A mixed balanced diet is a more sensible and healthy approach to weight reduction, while an unsupervised limited and an unbalanced diet could be unhealthy due to the loss of macro and micro elements.<sup>2</sup> Further controlled research with a larger sample size is warranted.

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