

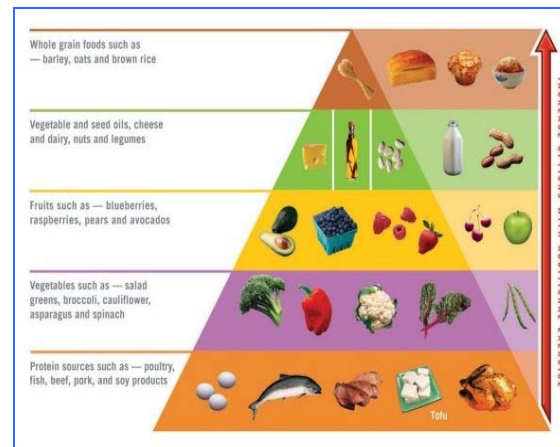
Low Carbohydrate Diets in People with Type 2 Diabetes Mellitus. What are the barriers to compliance and are they nutritionally adequate?

Summary of Findings

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Aim: To investigate nutritional adequacy, compliance and barriers to compliance to a low carbohydrate diet in a group of people with type 2 diabetes mellitus.

Design: A literature review investigated nutritional adequacy and compliance to low carbohydrate diets. Participants followed a low carbohydrate diet, based on Dr. Atkins principles, for 6 months. Participants attended fortnightly group meetings with a Dietitian. Every fortnight weight, waist circumference and fat percentage was measured. Three-day food diaries were completed at baseline, interim (3mo) and final (6mo) stages of study. Nutrient analysis was carried out using Diet Cruncher. Serum HbA_{1c} levels was measured at baseline, interim and final stages. Participant's measured urinary ketones each day. Participants were provided with a general multivitamin supplement. All participants were encouraged to maintain current levels of physical activity. A questionnaire was given to participants at the end of the study to assess barriers to compliance.



Participants: Fourteen participants were recruited from advertising at the hospital and with advertisements located in local newspapers. Participants were included if they had known established diabetes requiring oral hypoglycaemic agents or insulin, were aged between 30 to 65 yrs and had a BMI >27 kg/m². Exclusion criteria for subjects was pregnancy, lactation, kidney or liver disease, malignancy, severe cardiovascular disease, psychiatric illness, drug or alcohol dependency, recent weight loss >3kg in the three months prior to study, chronic inflammatory disease, such as inflammatory bowel disease; steroid or anti-inflammatory medications and lipid lowering therapy.

Literature Review Results: There is very little research on the nutritional adequacy and compliance to low carbohydrate diets. Only one other study has looked at low carbohydrate diets in people with type 2 diabetes¹. Many studies found low carbohydrate diets to be effective for weight loss, but this was not significantly different from conventional weight loss diets after 1 year². Studies have found inadequate intakes of fibre, folate, calcium, magnesium and fat-soluble vitamins in low carbohydrate diets³. There are many barriers to compliance for individuals, including psychological stress, cost and lack of will power⁴.

Participant Results:

- Twelve participants completed the study.
- Mean age was 47 years old.
- Mean time participants had been diagnosed with Type 2 Diabetes Mellitus was 5 years
- Mean body mass index was 41kg/m²
- Mean weight loss was 9.7kg
- Mean body fat loss was 8kg
- Mean decrease in waist circumference was 8.5cm.
- Mean decrease in HbA_{1c} was 1.1%



Energy Intake Results:

The energy deficit at interim and final measures has come from a decrease in overall carbohydrate intake, with maintenance of fat and protein intakes over the study period.

Figure 1: Macronutrient make-up of total energy intake

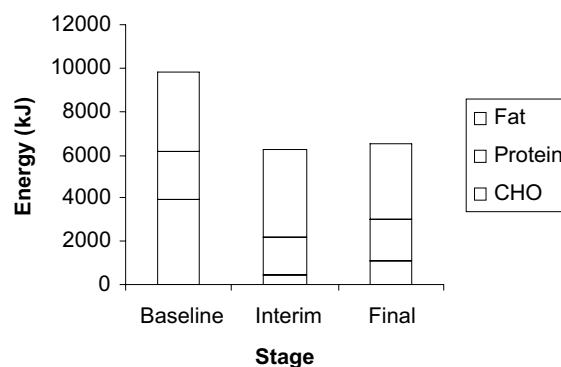
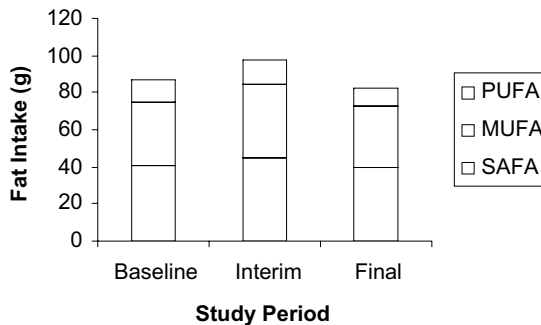


Figure 2: Polyunsaturated, Monounsaturated, Saturated Fatty Acid make-up of Total Fat



Fat Intake Results:

Fat intake increased at the interim period due to increased intakes of SAFA and MUFA. Intakes of SAFA over the study period remained above recommended intake levels.

Questionnaire Results:

- All participants stated that they would continue with the diet if they needed to.
- The majority of the participants found the diet 'easy' to follow.
- Participants were able to follow the diet for at least 4 days per week.
- Compliance to the diet was difficult in social situations, such as business meetings or family gatherings.
- Half of the participants found the diet difficult/boring to follow.
- The factors that help participants with compliance were improved HbA_{1c} levels, good blood sugar levels, and a belief that they could benefit other people with diabetes.
- Throughout the study the majority of the participants were "motivated", "happy" and "enthusiastic".
- Four participants had diarrhoea in the first two weeks. At interim stage three participants had diarrhoea, but this decreased to two participants by the final stage. Two participants had constipation throughout the study period.
- Seven participants did not feel hungry in the first two weeks. As carbohydrate intake increased two participants found that their hunger increased.
- Four participants found their grocery bill was the same as before starting the study. Two participants thought that it was \$10/week more and three found it \$30 more a week.

Nutrient Analysis:

All measured nutrients stayed within recommended daily intake values, except for:

- Fibre intake decreased from 25 ± 10.8 g/day at baseline to 8.6 ± 3.6 g/day at interim and 11.7 ± 3.9 g/day at final.
- Calcium intake was 1015 ± 517 mg/day at baseline and the intake decreased to 740 ± 533 mg/day at interim and to 482 ± 134 mg/day at final.
- Magnesium levels fell below recommended levels to 250 ± 87 mg/day at final.
- Vitamin D that decreased to 3.44 ± 2.53 ug/day at baseline and 4.48 ± 4.2 ug/day at final readings
- Folate intake decreased to 200 ± 43.3 ug/day at interim and at final to 236 ± 70.2 ug/day.



Conclusions: A low carbohydrate diet is not likely to give adequate intakes of fibre, calcium, magnesium, vitamin D, potassium or folate. Compliance to the diet was reported to be high, but due to the results of the ketone sticks, diet records and HbA_{1c} results it can be seen that participants did not comply with the diet throughout the entire study. More study is needed on the safety of long-term use of low carbohydrate diets in people with type 2 diabetes.

References:

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3. Meckling, K.A. O'Sullivan, C., Saari, D. Comparison of a low-fat diet to a low-carbohydrate diet on weight loss, body composition, and risk factors for diabetes and cardiovascular disease in free-living, overweight men and women. *The Journal of Clinical Endocrinology and Metabolism*. 2004; 89 (6): 2717-2723.
4. Ministry of Health Publication. NZ Food: NZ People. Key Results of the National Nutrition Survey. Wellington: Ministry of Health; 1999.

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