Vegetarian diet improves insulin resistance and oxidative stress markers more than conventional diet in subjects with Type 2 diabetes

Kahleova H, Matoulek M, Malinska H, Oliyarnik O, Kazdova L, Neskudla T, Skoch A, Hajek M, Hill M, Kahle M, Pelikanova T. Vegetarian diet improves insulin resistance and oxidative stress markers more than conventional diet in subjects with Type 2 diabetes. Diabet Med. 2011 May;28(5):549-59. doi: 10.1111/j.1464-5491.2010.03209.x. PMID: 21480966; PMCID: PMC3427880.

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BACKGROUND

Prevalence of type 2 diabetes is 50% lower in vegetarians compared to non-vegetarians.

- Intervention studies in type 2 diabetes patients, with vegetarian diets compared to conventional diets used to treat diabetes, show greater:
  - Weight loss
  - Reduction in fasting plasma glucose
  - Improvement in HbA1c
  - Improvement in fasting and postprandial lipids
  - Reduction of diabetes medication
- Exercise training, reduces insulin resistance due to:
  - Preferential loss of visceral fat
  - Stimulation of muscle development
  - Increased skeletal muscle insulin action
  - Morphological changes in muscle
  - Improved control over hepatic glucose production

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AIM

The aim of this study was to compare the effects of calorie restricted vegetarian and conventional diabetic diets alone and in combination with exercise on insulin resistance, visceral fat and oxidative stress markers in subjects with Type 2 diabetes.

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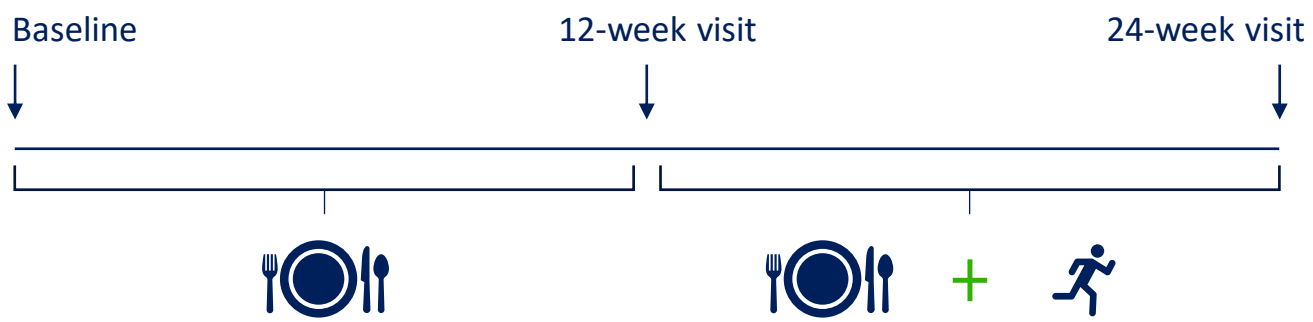
METHODS

- **Subjects**: type 2 diabetes patients treated by oral hypoglycaemic agents
- **Study design**: randomised, controlled, open label, parallel group
- Randomly allocated to one of two isocaloric, calorie restricted (-500 kcal / day) diets:
  - Vegetarian diet (experimental group)
  - Conventional diabetic diet according to the dietary guidelines of the Diabetes and Nutrition Study Group (DNSG) of the European Association for the Study of Diabetes (EASD) (control group).
- **Study duration**: 24 weeks (the second 12 weeks of the diet were combined with aerobic exercise in both groups)
- **Primary outcomes:** insulin sensitivity, volume of visceral and subcutaneous fat and oxidative stress

74 subjects randomised



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RESULTS

- Diabetes medication was reduced in cases of repeated hypoglycaemia in 43% of participants in the experimental group and in 5% of participants in the control group ($P < 0.001$).
- An increase in insulin sensitivity was significantly greater in the experimental group than in the control group (30% vs. 20%, $P = 0.04$).
- HbA1c significantly decreased in both groups during the first 12 weeks ($P < 0.001$). It remained reduced after exercise. The decrease from baseline to 24 weeks was significant only in the experimental group ($P = 0.002$).

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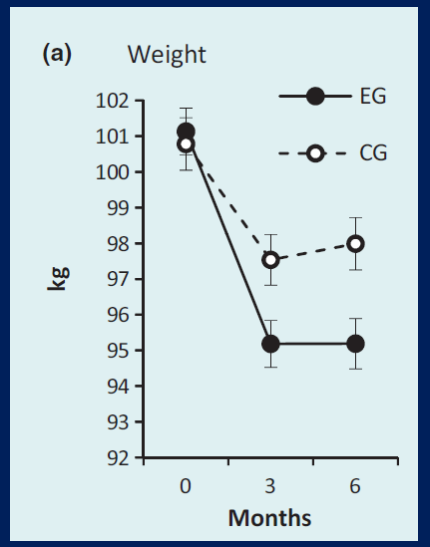
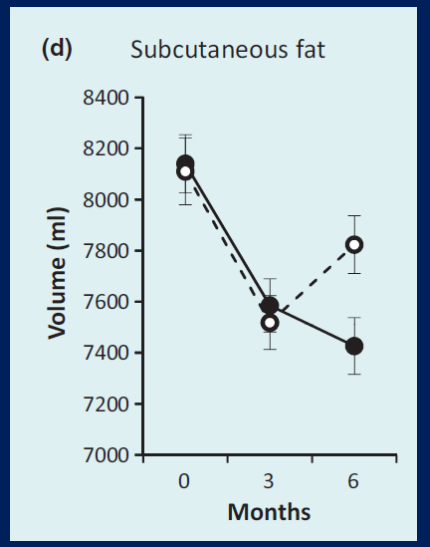
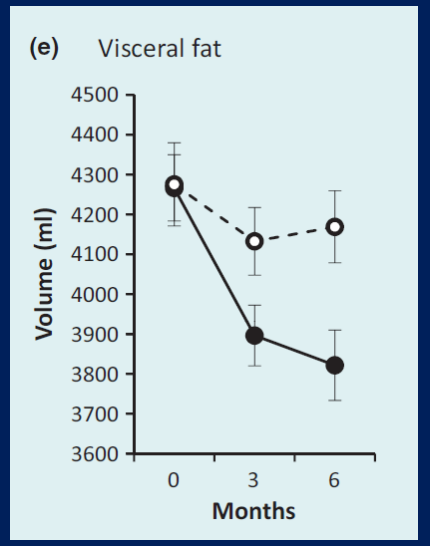
RESULTS

- Body weight decreased more in the experimental group than in the control group (-6.2kg vs -3.2kg; interaction group x time P = 0.001).
- A reduction in both visceral and subcutaneous fat was greater in the experimental group than in the control group (P = 0.007 and P = 0.02, respectively).







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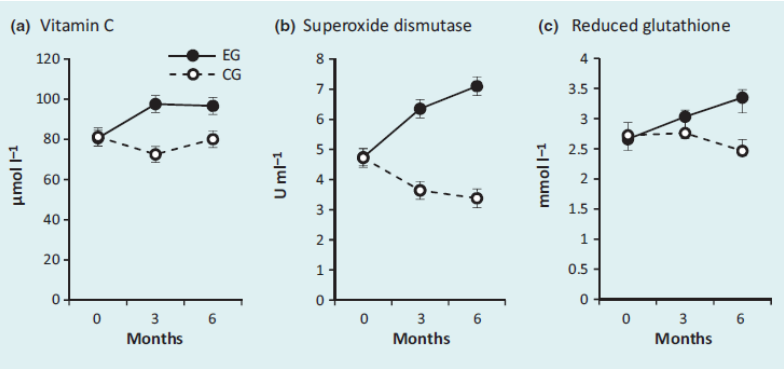
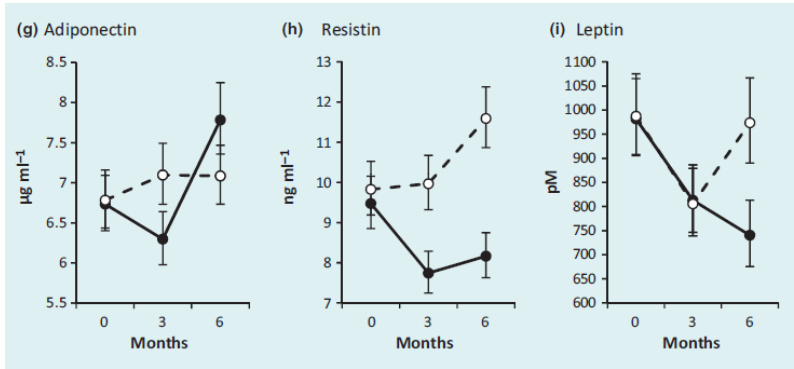
RESULTS





Oxidative stress markers

Vitamin C, superoxide dismutase and reduced glutathione increased in the experimental group ($P = 0.002$, $P < 0.001$ and $P = 0.02$, respectively).

Adipokines

Adiponectin increased ($P<0.05$) and resistin and leptin ($P=0.02$) decreased in the experimental group.

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CONCLUSION

"A calorie-restricted vegetarian diet had greater capacity to improve insulin sensitivity compared with a conventional diabetic diet over 24 weeks. The greater loss of visceral fat and improvements in plasma concentrations of adipokines and oxidative stress markers with this diet may be responsible for the reduction of insulin resistance. The addition of exercise training further augmented the improved outcomes with the vegetarian diet".

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Vegetarian diet improves insulin resistance and oxidative stress markers more than conventional diet in subjects with Type 2 diabetes

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Abstract

Aims The aim of this study was to compare the effects of calorie-restricted vegetarian and conventional diabetic diets alone and in combination with exercise on insulin resistance, visceral fat and oxidative stress markers in subjects with Type 2 diabetes.

Methods A 24-week, randomized, open, parallel design was used. Seventy-four patients with Type 2 diabetes were randomly assigned to either the experimental group (n = 37), which received a vegetarian diet, or the control group (n = 37), which received a conventional diabetic diet. Both diets were isocaloric, calorie restricted (-500 kcal/day). All meals during the study were provided. The second 12 weeks of the diet were combined with aerobic exercise. Participants were examined at baseline, 12 weeks and 24 weeks. Primary outcomes were: insulin sensitivity measured by hyperinsulinaemic isoglycaemic clamp; volume of visceral and subcutaneous fat measured by magnetic resonance imaging; and oxidative stress measured by thiobarbituric acid reactive substances. Analyses were by intention to treat.

Results Forty-three per cent of participants in the experimental group and 5% of participants in the control group reduced diabetes medication ($P < 0.001$). Body weight decreased more in the experimental group than in the control group [–6.2 kg (95% CI –6.6 to –5.3) vs. –3.2 kg (95% CI –3.7 to –2.5); interaction group × time $P = 0.001$]. An increase in insulin sensitivity was significantly greater in the experimental group than in the control group [30% (95% CI 24.5–39) vs. 20% (95% CI 14–25), $P = 0.04$]. A reduction in both visceral and subcutaneous fat was greater in the experimental group than in the control group ($P = 0.007$ and $P = 0.02$, respectively). Plasma adiponectin increased ($P = 0.02$) and leptin decreased ($P = 0.02$) in the experimental group, with no change in the control group. Vitamin C, superoxide dismutase and reduced glutathione increased in the experimental group ($P = 0.002$, $P < 0.001$ and $P = 0.02$, respectively). Differences between groups were greater after the addition of exercise training. Changes in insulin sensitivity and enzymatic oxidative stress markers correlated with changes in visceral fat.

Conclusions A calorie-restricted vegetarian diet had greater capacity to improve insulin sensitivity compared with a conventional diabetic diet over 24 weeks. The greater loss of visceral fat and improvements in plasma concentrations of adipokines and oxidative stress markers with this diet may be responsible for the reduction of insulin resistance. The addition of exercise training further augmented the improved outcomes with the vegetarian diet.

Diabet. Med. 28, 549–559 (2011)

Keywords exercise, insulin resistance, oxidative stress markers, vegetarian diet, visceral fat

Introduction

Type 2 diabetes is only half as prevalent in vegetarians compared with non-vegetarians [1,2]. Randomized controlled intervention studies in patients with Type 2 diabetes have shown greater weight loss, reduction in fasting plasma glucose [3], greater improvements in HbA_{1c} and fasting and postprandial lipids [4,5], and reduction of diabetes medications [3–5] with vegetarian diets

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