

ERNÆRINGSFOKUSKONFERENCEN
2023



Nyt fra CUT-DM – ny anbefaling for
makronæringsstoffordeling til personer med type 2
diabetes?

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UNIVERSITY OF COPENHAGEN



Age-adjusted Percentage of U.S. Adults with Obesity or Diagnosed Diabetes

Obesity (BMI ≥ 30 kg/m²)



Diabetes



CDC's Division of Diabetes Translation, National Diabetes Surveillance System available at <http://www.cdc.gov/diabetes/statistics>



T2DM AND NUTRITION

- Medical nutrition therapy is the mainstay of treatment of T2D. Compliance results in improved glycaemic control and reduction of CV risk regardless of duration of disease.
- Weight loss (typically >5%) has been the most consistent nutrition-related determinant of positive outcomes.
- Reducing excess adiposity is the cornerstone of all nutrition recommendations for prevention and treatment of T2D.

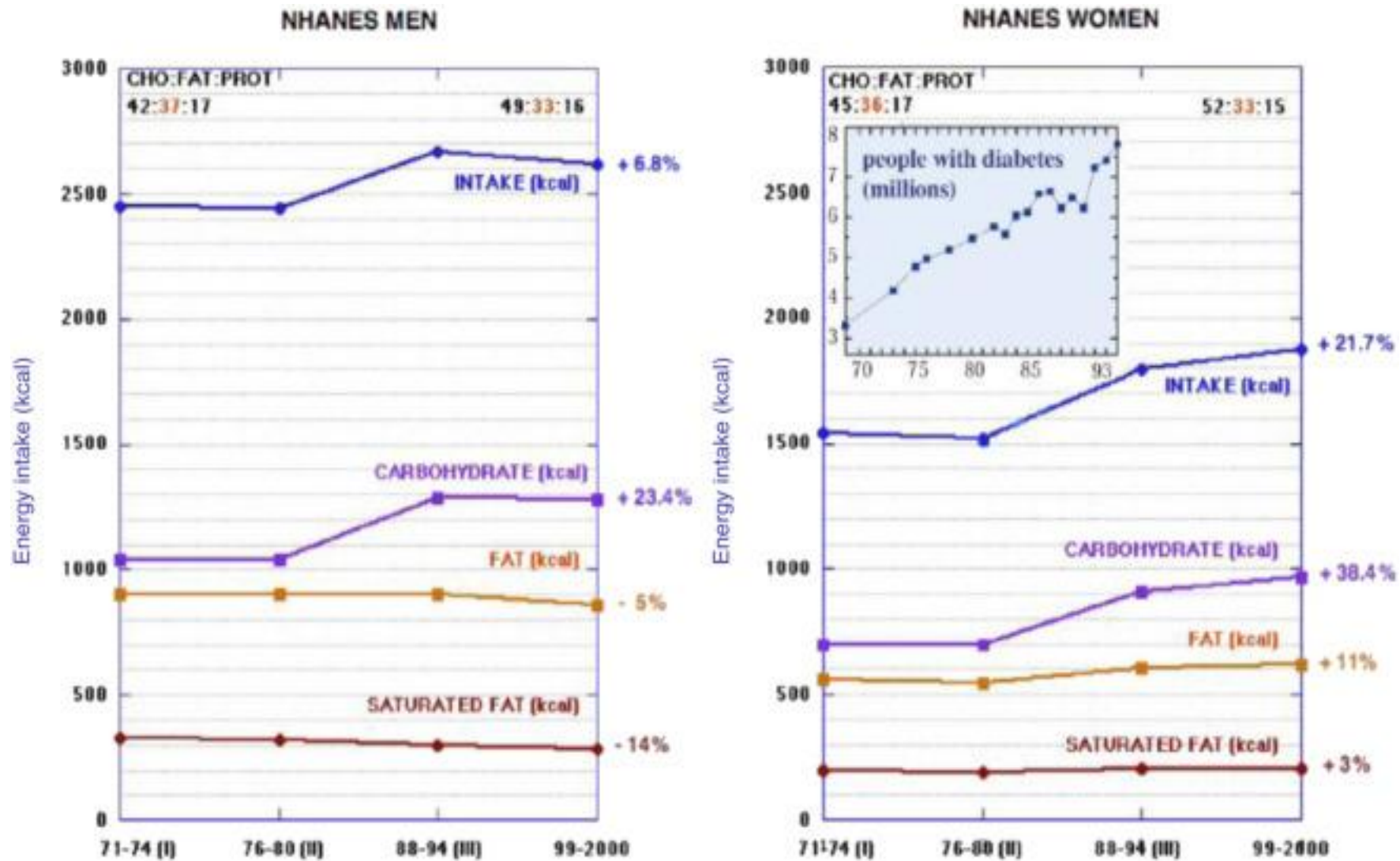


Fig. 2. Macronutrient consumption during the epidemic of obesity and type 2 diabetes. Data from the National Health and Nutrition Examination Survey (NHANES) by year, and from Centers for Disease Control and Prevention [19]. **Inset:** Incidence of diabetes (millions of people with diabetes by indicated year). Data from [17]. CHO, carbohydrate; Prot, protein.

Nutrition in a historical perspective

In 1977, after years of discussion, scientific review, and debate, the U.S. Senate Select Committee on Nutrition and Human Needs, led by Senator George McGovern, released [*Dietary Goals for the United States*](#). The Dietary Goals recommended:

To avoid overweight, consume only as much energy as is expended; if overweight, decrease energy intake and increase energy expenditure.

Increase the consumption of complex carbohydrates and “naturally occurring” sugars from about 28 percent of intake to about 48 percent of energy intake.

Reduce the consumption of refined and processed sugars by about 45 percent to account for about 10 percent of total energy intake.

Reduce overall fat consumption from approximately 40 percent to about 30 percent of energy intake.

Reduce saturated fat consumption to account for about 10 percent of total energy intake; and balance that with polyunsaturated and monounsaturated fats, which should account for about 10 percent of energy intake each.

Reduce cholesterol consumption to about 300 milligrams a day.

Limit the intake of sodium by reducing the intake of salt to about 5 grams a day.

TABLE 1Recommendations for medical nutrition therapy for people with diabetes¹

Variables	BDA (19)	ADA (22)	EASD (21)	CDA (20)
Carbohydrates (%)	50–55	50–60	45–60	50–60
GI (%)	—	Not recommended for general use	Recommended	Recommended
Fiber	<30 g/d	No specific amount	Increase with low-GI foods	25–35 g/d
Protein (%)	10–15	15–20	10–20	11
Fat (%)	30–35	25–35	≤35	≤30

¹ ADA, American Diabetes Association; AHA, American Heart Association; BDA, British Diabetic Association; CDA, Canadian Diabetes Association; EASD, European Association for the Study of Diabetes; GI, glycemic index; NCEP, National Cholesterol Education Program.

	Japan (24)	South Africa (25)	India (23)	AHA (26)	NCEP (27)
	60	55–60	>65	45–55	50–60
Recommended	—	Recommended	—	—	—
1 fruit, 400 g vegetables		40 g/d	No specific amount	≥25 g/d	20–30 g/d
15–20		12–20	No specific amount	15	15
20–25		<30	<21	<30	25–35

association; CDA, Canadian Diabetes Association; EASD, European Association for the Study of

SPECIAL ARTICLE

Evidence-based nutritional approaches to the treatment and prevention of diabetes mellitus

J.I. Mann (coordinator), Dunedin, New Zealand; I. De Leeuw, Antwerp, Belgium; K. Hermansen, Aarhus, Denmark; B. Karamanos, Athens, Greece; B. Karlström, Uppsala, Sweden; N. Katsilambros, Athens, Greece; G. Riccardi, Naples, Italy; A.A. Rivellese, Naples, Italy; S. Rizkalla, Paris, France; G. Slama, Paris, France; M. Toeller, Düsseldorf, Germany; M. Uusitupa, Kuopio, Finland; B. Vessby, Uppsala, Sweden, on behalf of the **Diabetes and Nutrition Study Group (DNSG) of the European Association for the Study of Diabetes (EASD)**

Carbohydrates and T2DM

Diabetes Nutrition Study Group 2005

- The reason for high carbohydrate diet is a simple calculation:
- Fat (30 E%), Protein (15 E%)
- The remainder = 55 E% carbohydrate!

Medical Technology Evaluation 2003

NON-PHARMACOLOGICAL TREATMENT OF TYPE 2 DIABETES

It is the total amount of carbohydrates in the meal, which is decisive for the glucose response.

Carbohydrate restriction in type 2 diabetes

Suggested by Chen and Reaven et al. in 1995 - Diabetes Care ¹

Diabetes Care Volume 42, May 2019

731



First consensus report to officially recommend dietary carbohydrate restriction

Nutrition Therapy for Adults With Diabetes or Prediabetes: A Consensus Report

Diabetes Care 2019;42:731–754 | <https://doi.org/10.2337/dci19-0014>

Alison B. Evert,¹ Michelle Dennison,² Christopher D. Gardner,³ W. Timothy Garvey,^{4,5} Ka Hei Karen Lau,⁶ Janice MacLeod,⁷ Joanna Mitri,⁸ Raquel F. Pereira,⁹ Kelly Rawlings,¹⁰ Shamera Robinson,¹¹ Laura Saslow,¹² Sacha Uelmen,¹¹ Patricia B. Urbanski,¹³ and William S. Yancy Jr.^{14,15}

¹Chen, Y. D., et al., *Diabetes Care*, 1995

MACRONUTRIENTS

Consensus recommendations

- Evidence suggests that there is not an ideal percentage of calories from carbohydrate, protein, and fat for all people with or at risk for diabetes; therefore, macronutrient distribution should be based on individualized assessment of current eating patterns, preferences, and metabolic goals.



Nutrition Therapy for Adults With
Diabetes or Prediabetes:
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PhD defence by Amirsalar Agertoft Samkani
May 28th 2019, Bispebjerg University Hospital

<p>Low-carbohydrate (110–112)</p>	<p>Emphasizes vegetables low in carbohydrate (such as salad greens, broccoli, cauliflower, cucumber, cabbage, and others); fat from animal foods, oils, butter, and avocado; and protein in the form of meat, poultry, fish, shellfish, eggs, cheese, nuts, and seeds. Some plans include fruit (e.g., berries) and a greater array of nonstarchy vegetables. Avoids starchy and sugary foods such as pasta, rice, potatoes, bread, and sweets. There is no consistent definition of “low” carbohydrate. In this review, a low-carbohydrate eating pattern is defined as reducing carbohydrates to 26–45% of total calories.</p>	<ul style="list-style-type: none"> • A1C reduction • Weight loss • Lowered blood pressure • Increased HDL-C and lowered triglycerides
<p>Very low-carbohydrate (VLC) (110–112)</p>	<p>Similar to low-carbohydrate pattern but further limits carbohydrate-containing foods, and meals typically derive more than half of calories from fat. Often has a goal of 20–50 g of nonfiber carbohydrate per day to induce nutritional ketosis. In this review a VLC eating pattern is defined as reducing carbohydrate to <26% of total calories.</p>	<ul style="list-style-type: none"> • A1C reduction • Weight loss • Lowered blood pressure • Increased HDL-C and lowered triglycerides



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EATING PATTERNS

Consensus recommendations

- A variety of eating patterns (combinations of different foods or food groups) are acceptable for the management of diabetes.
- Until the evidence surrounding comparative benefits of different eating patterns in specific individuals strengthens, health care providers should focus on the key factors that are common among the patterns:
 - Emphasize nonstarchy vegetables.
 - Minimize added sugars and refined grains.
 - Choose whole foods over highly processed foods to the extent possible.
- Reducing overall carbohydrate intake for individuals with diabetes has demonstrated the most evidence for improving glycemia and may be applied in a variety of eating patterns that meet individual needs and preferences.
- For select adults with type 2 diabetes not meeting glycemic targets or where reducing anti-glycemic medications is a priority, reducing overall carbohydrate intake with low- or very low-carbohydrate eating plans is a viable approach.



Nutrition Therapy for Adults With Diabetes or Prediabetes: A Consensus Report

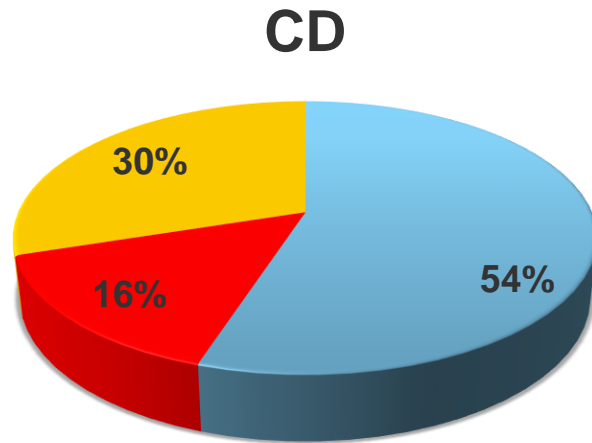
Diabetes Care 2019;42:731–754 | <https://doi.org/10.2337/dci19-0014>

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CutDM – four studies

- The Phenotype Study
- The Iso-energetic Study
- The Hypo-energetic Study
- The Meal-box Study

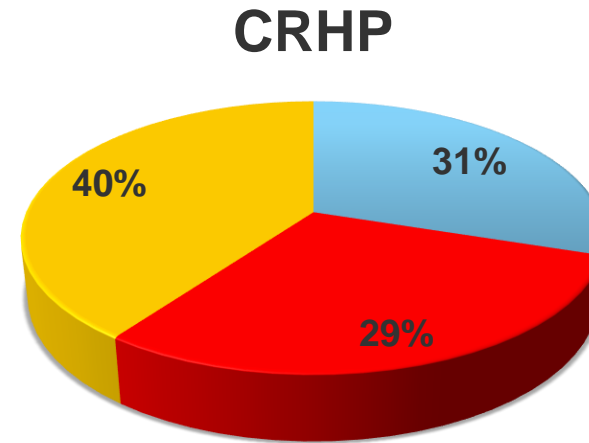
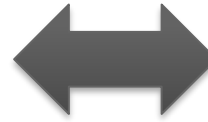
Intervention diets



■ Carbohydrate ■ Protein ■ Fat

CD: Conventional Diabetes

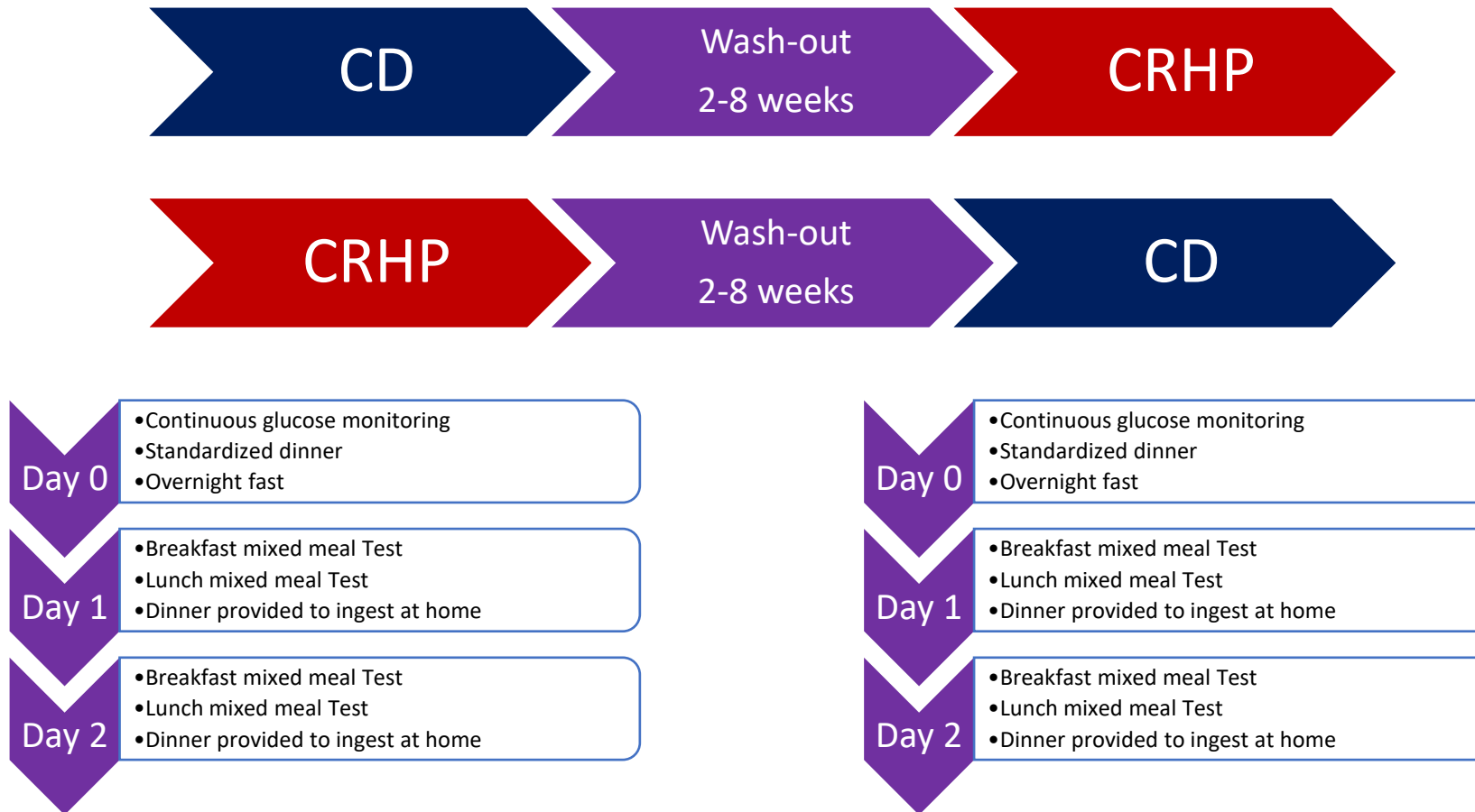
Iso-caloric



■ Carbohydrate ■ Protein ■ Fat

CRHP: Carbohydrate Reduced High Protein

Method – open-label randomized cross-over



All outcomes were assessed as means of day 1 and day 2

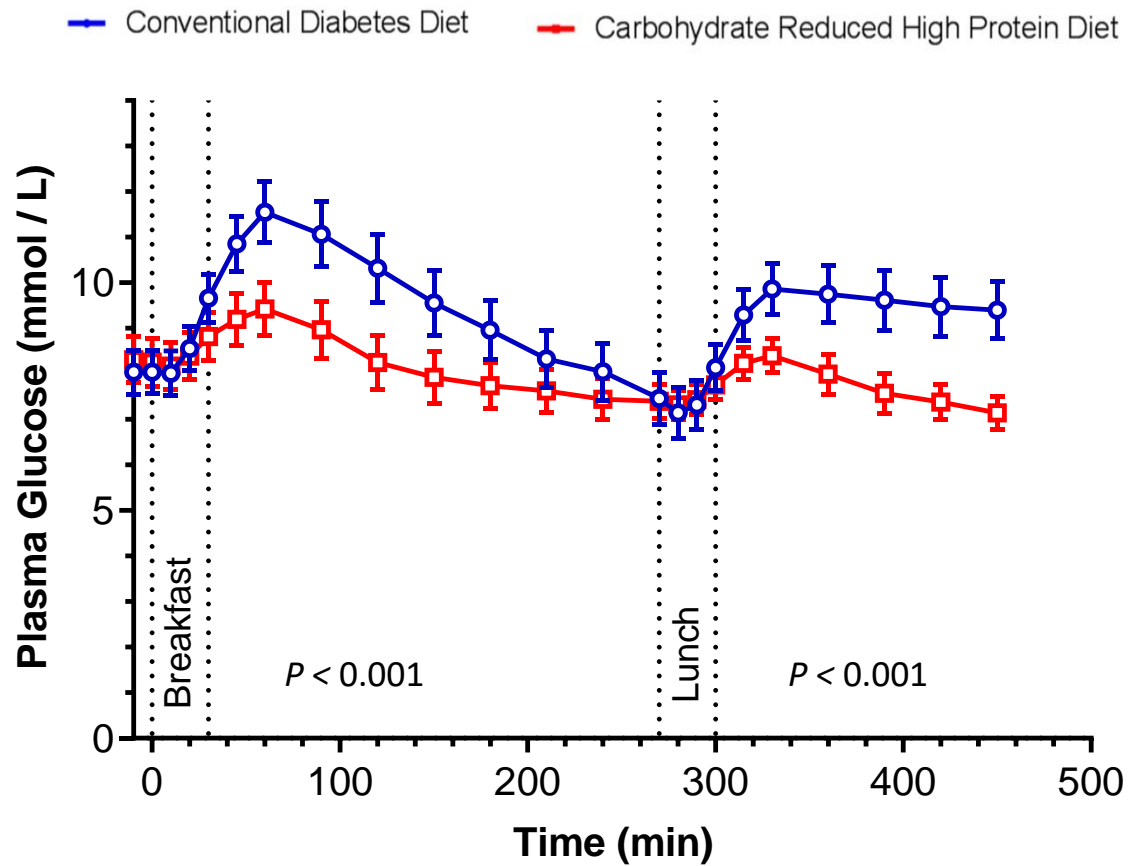
CD: Conventional Diabetes

CRHP: Carbohydrate-Reduced High-Protein

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Mixed meal test – Glucose

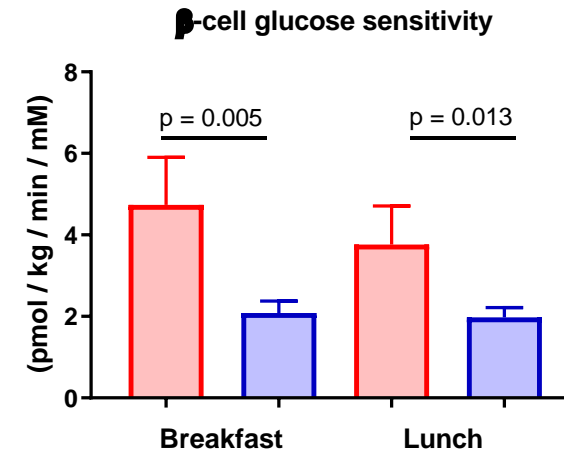
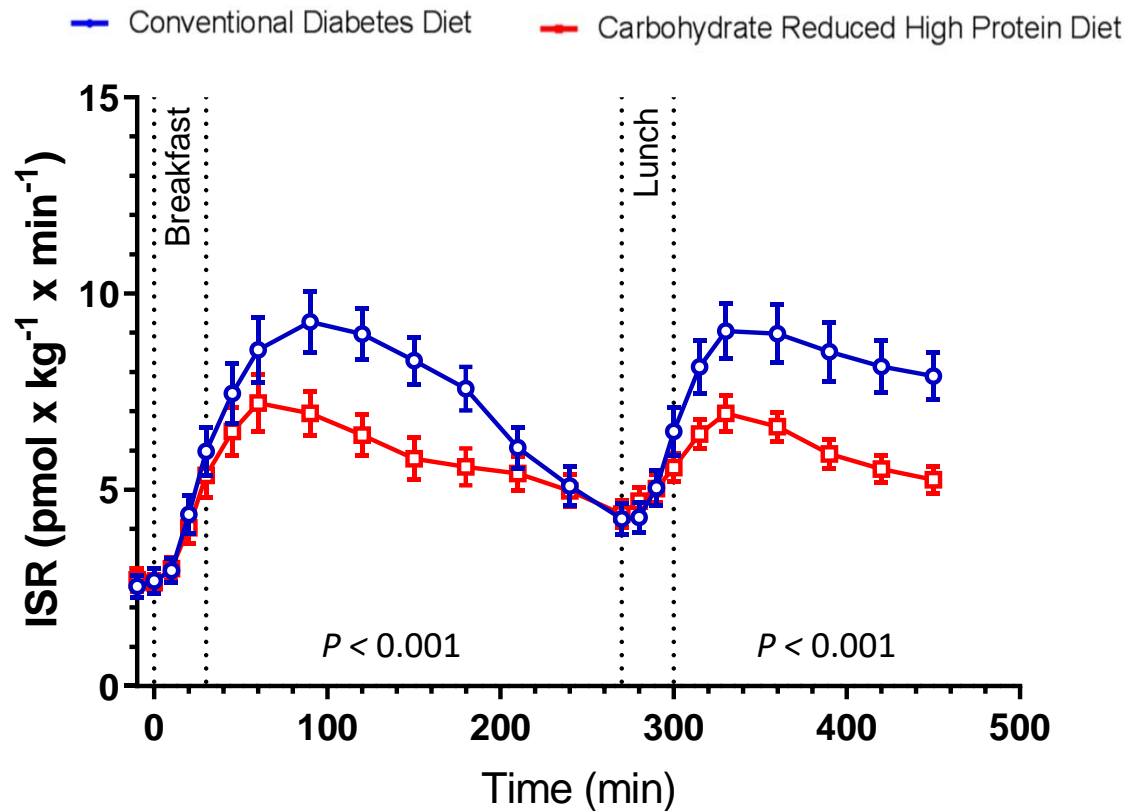


Peak glucose was reduced by 18% following breakfast and by 15% following lunch

Second-meal effect was observed on both diets

14% reduction in postprandial glucose

Mixed meal test – ISR and β -cell glucose sensitivity



May be due to deteriorated incretin effect¹ but maintained protein-stimulated insulin secretion in type 2 diabetes²

¹Nauck, M. A., et al., J Clin Invest, 1993

²Frid, A. H., et al., Am J Clin Nutr, 2005

21% reduction in insulin secretion rate

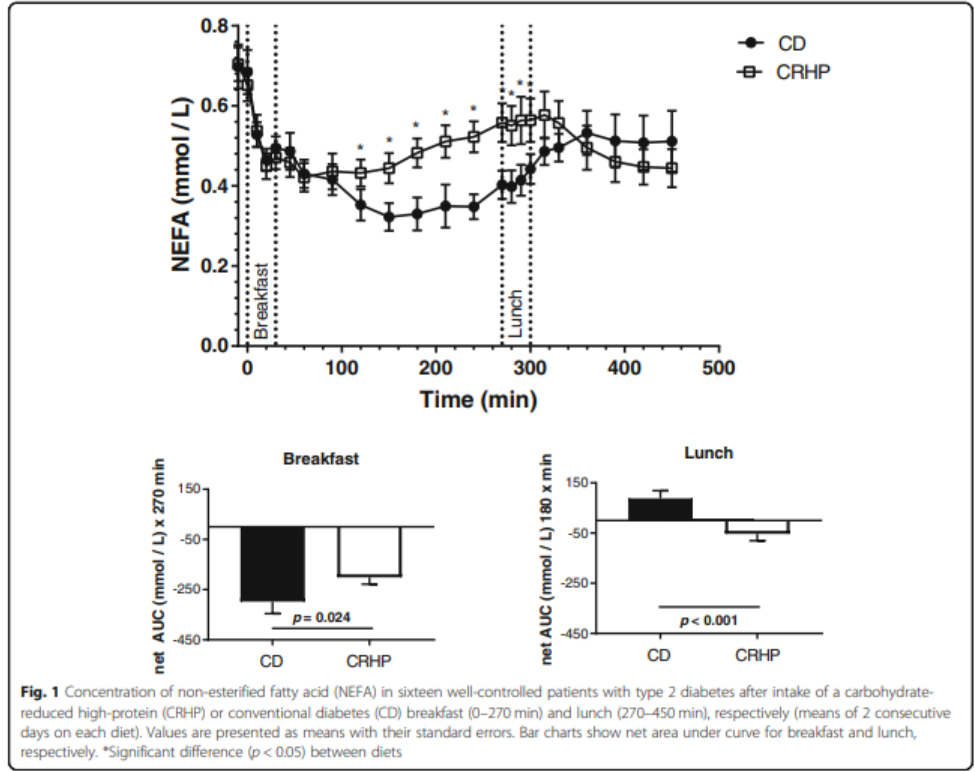
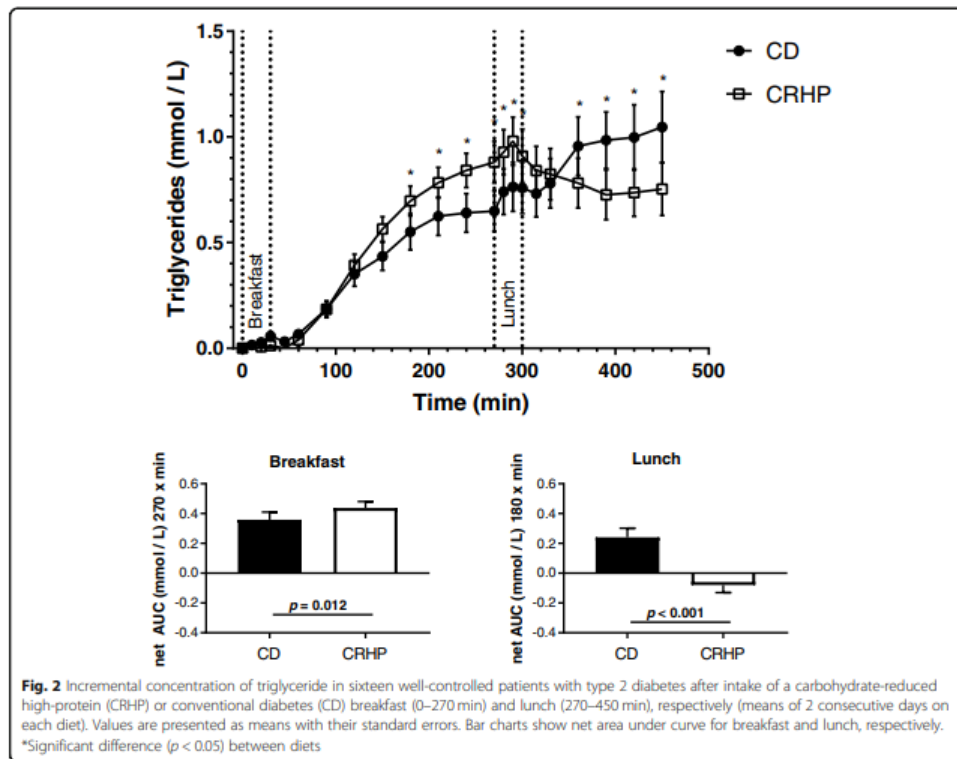
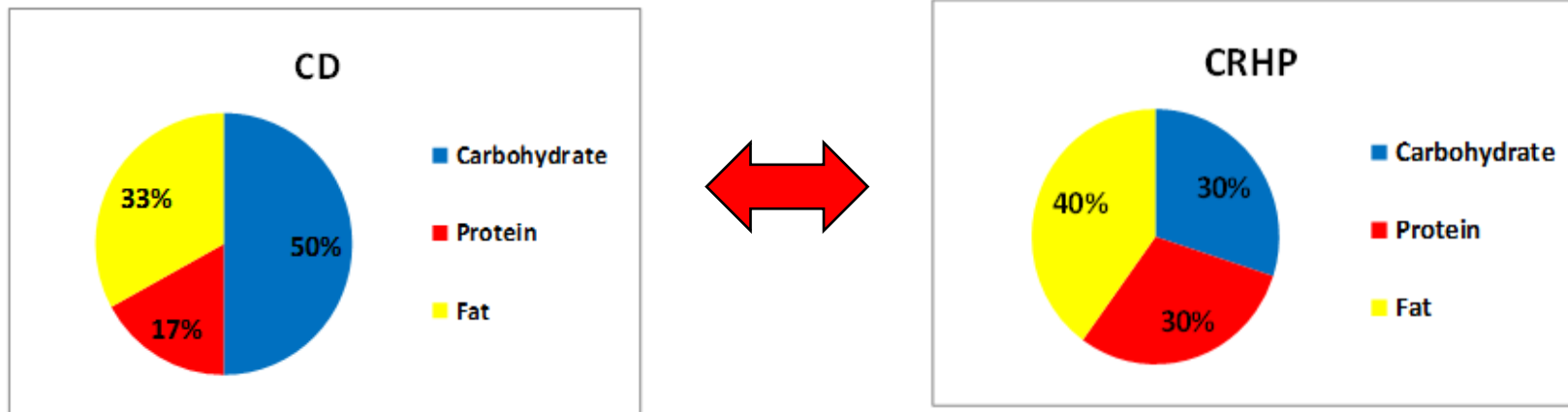


Fig. 1 Concentration of non-esterified fatty acid (NEFA) in sixteen well-controlled patients with type 2 diabetes after intake of a carbohydrate-reduced high-protein (CRHP) or conventional diabetes (CD) breakfast (0–270 min) and lunch (270–450 min), respectively (means of 2 consecutive days on each diet). Values are presented as means with their standard errors. Bar charts show net area under curve for breakfast and lunch, respectively. *Significant difference ($p < 0.05$) between diets



The Isoenergetic Study



Aim and hypothesis

To examine whether a carbohydrate reduced high protein (CRHP) diet compared with a conventional (CD) diet will:

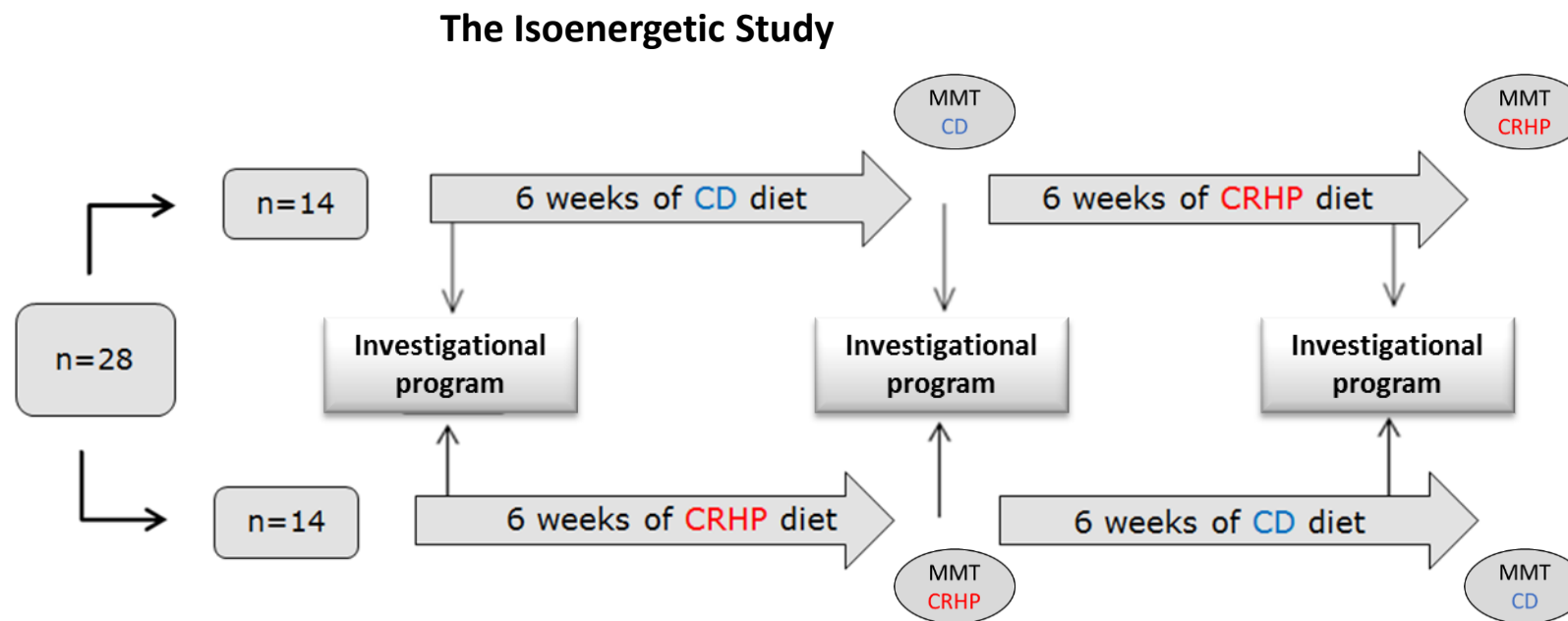
Improve metabolic control by

- reducing postprandial plasma glucose excursions
- reducing diurnal blood glucose excursions
- reducing HbA1c

Improve cardiovascular markers by

- increasing heart rate variability
- reducing diurnal blood pressure
- reducing fasting triglycerides

Method – open-label randomized cross-over



+ body weight stability

+ unchanged physical activity level

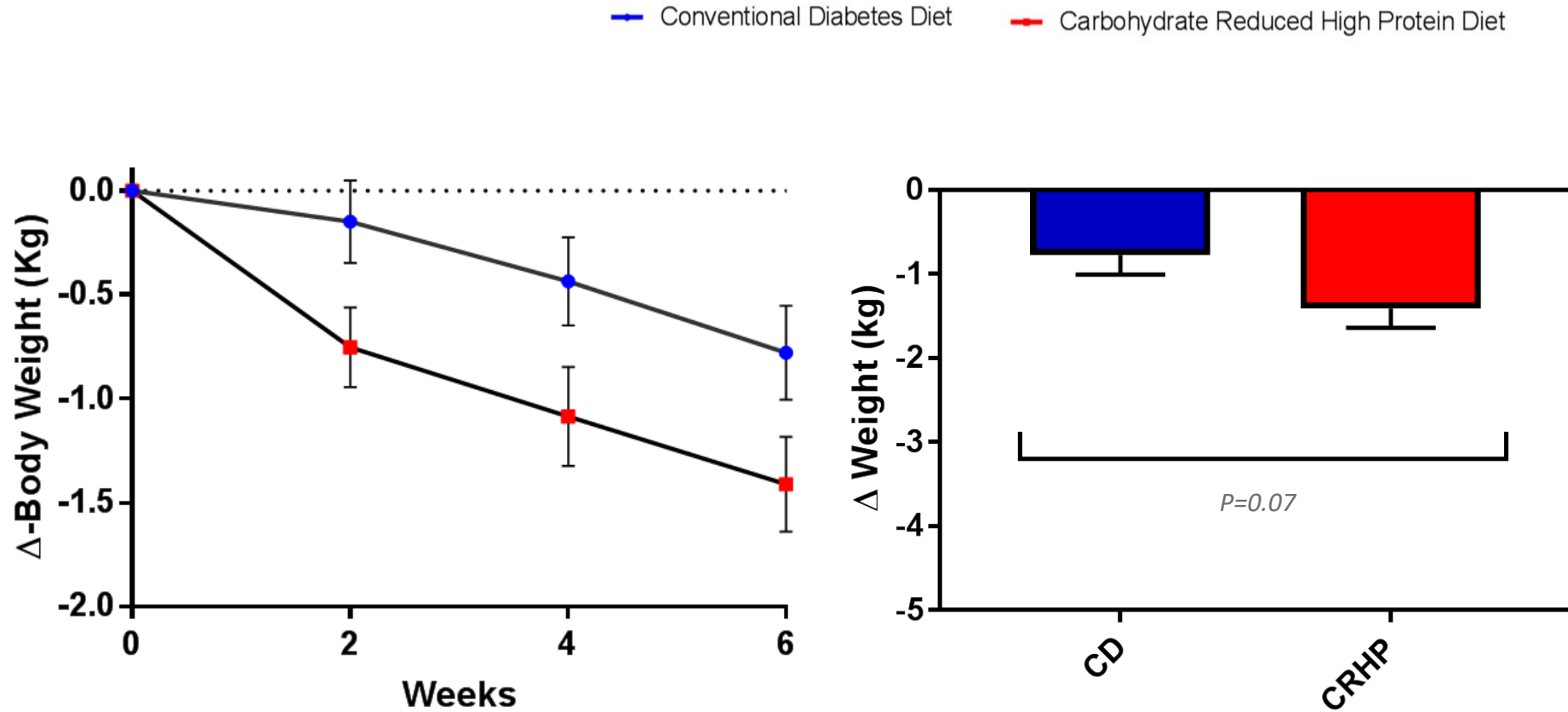
+ unchanged medication

+ full provision of all meals

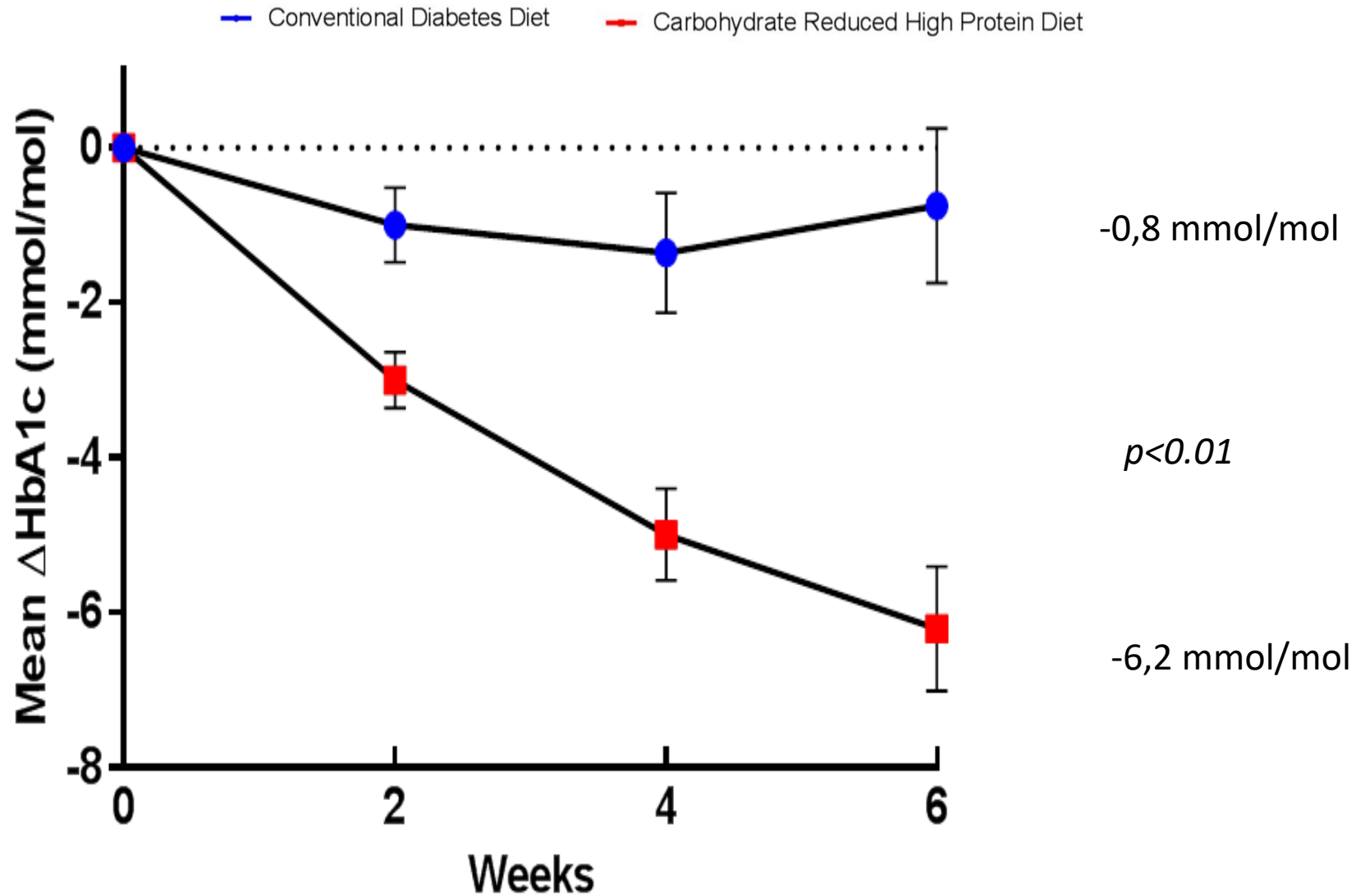
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Change in total body weight (kg)

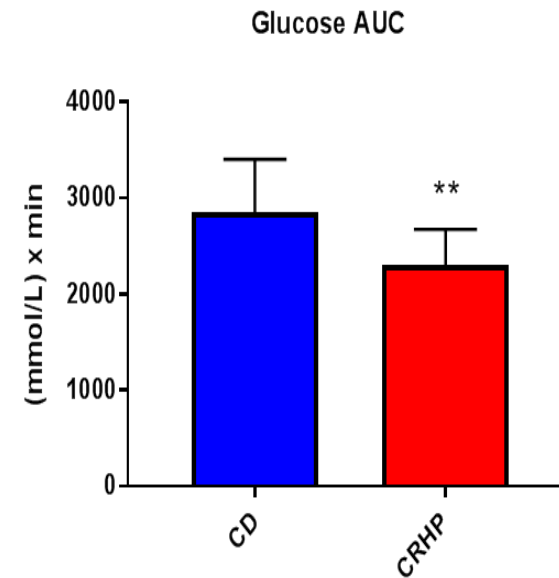
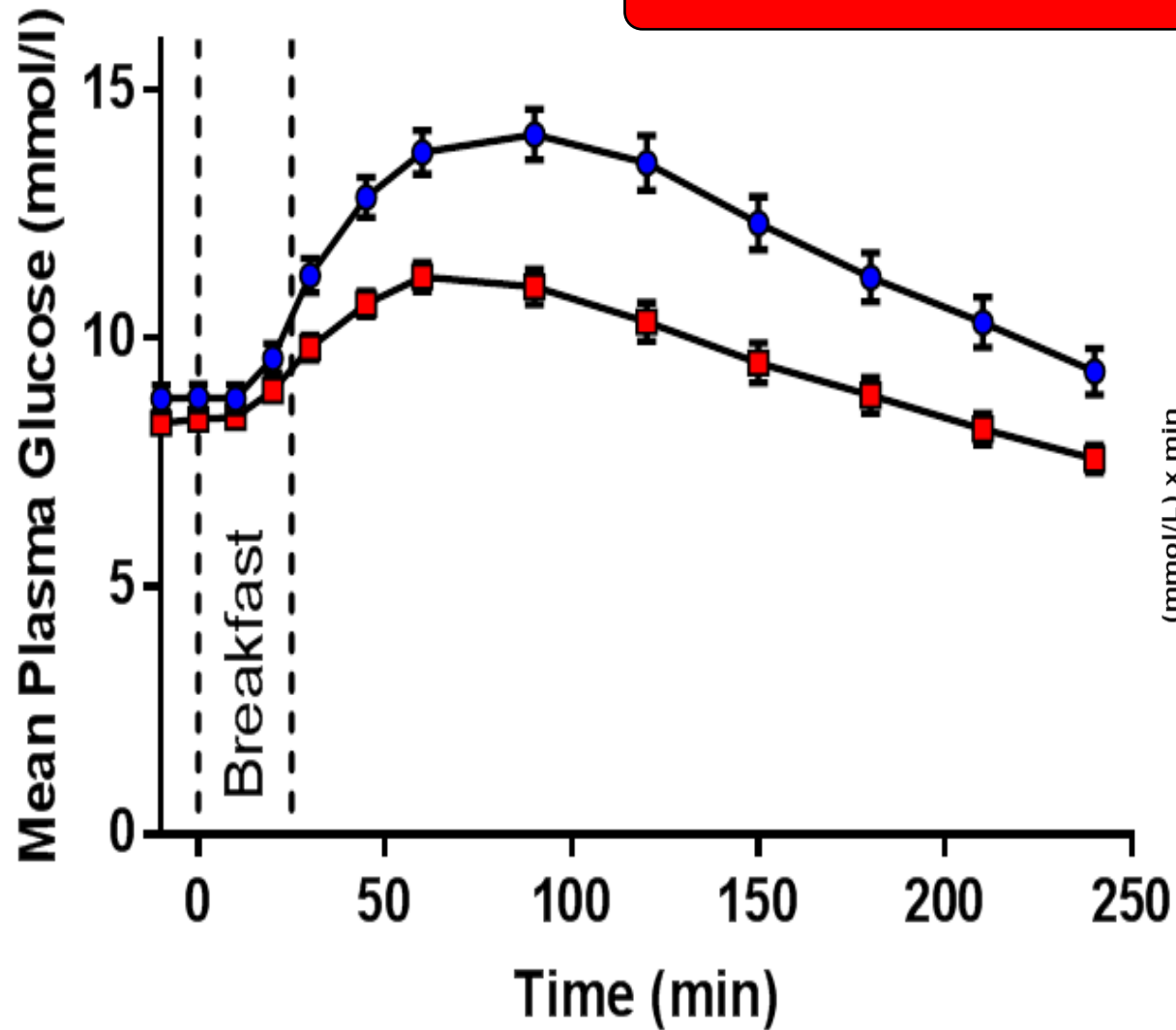


Change in HbA1c during 6 weeks of intervention



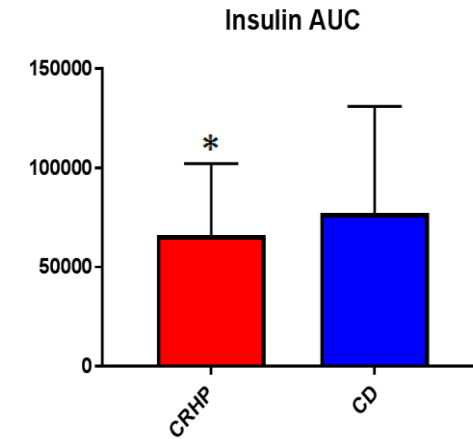
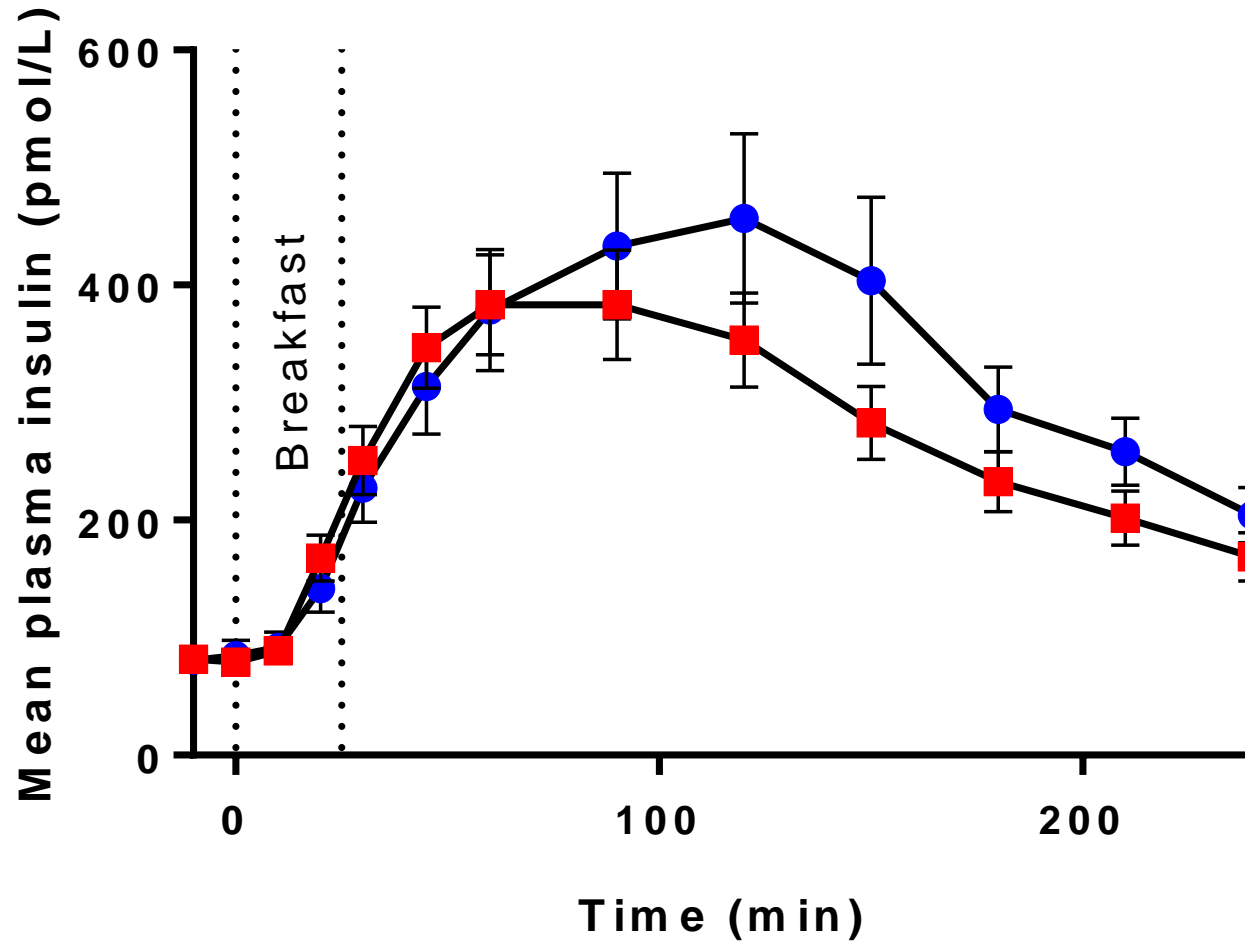
Mixed meal test – Mean plasma glucose

19% reduction in postprandial plasma glucose AUC



Mixed meal test – Mean plasma insulin

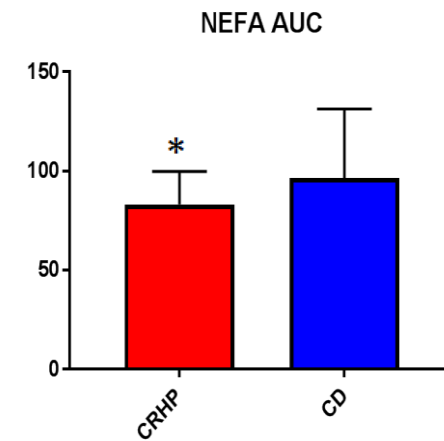
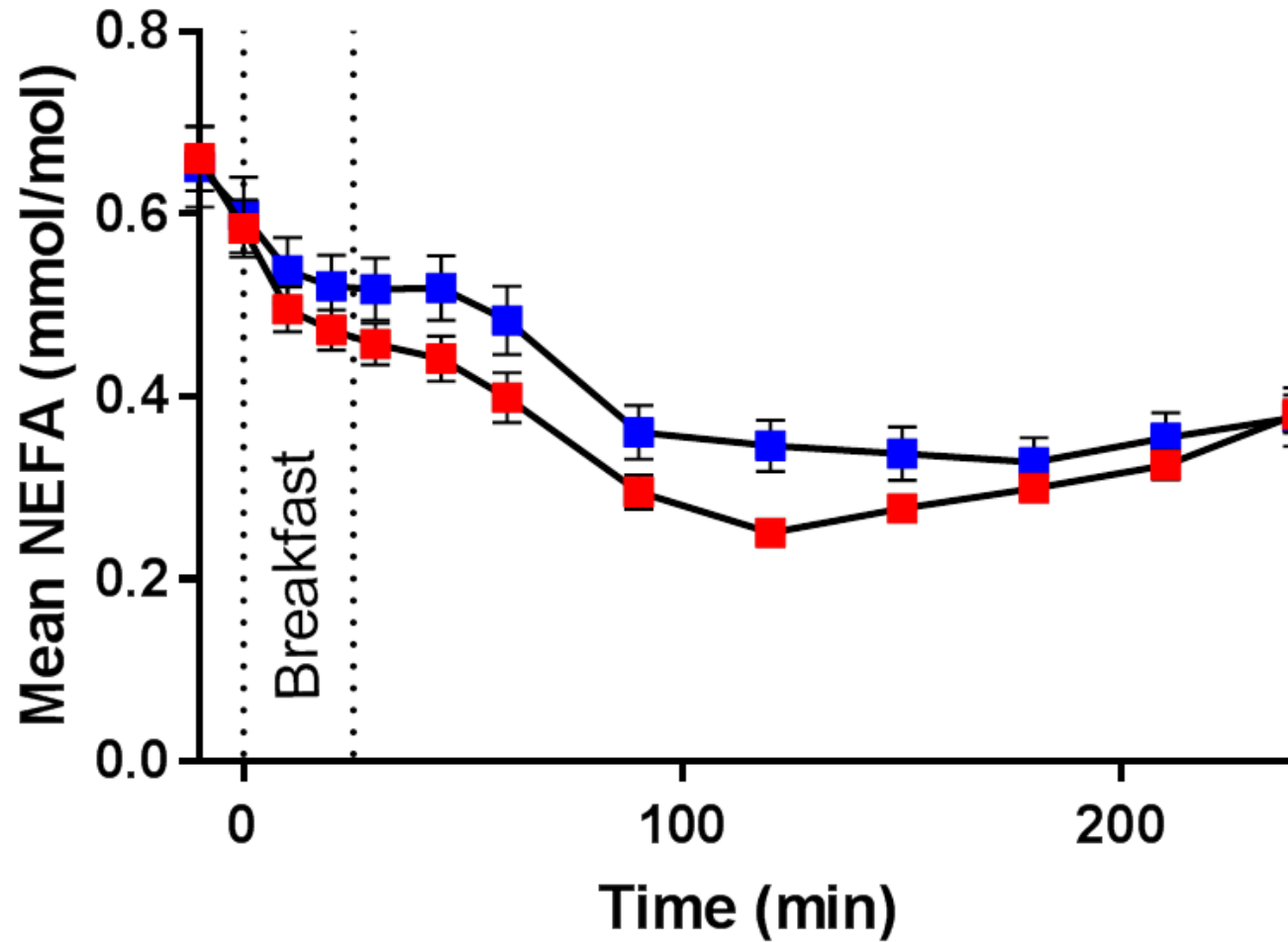
14.5% reduction in postprandial insulin AUC



Mixed meal test – Mean plasma

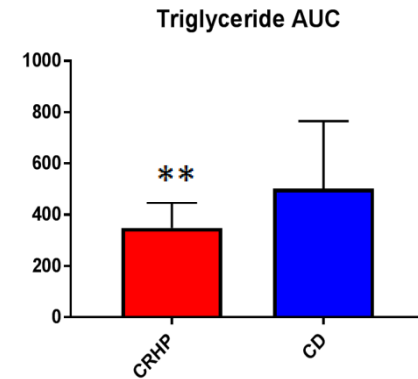
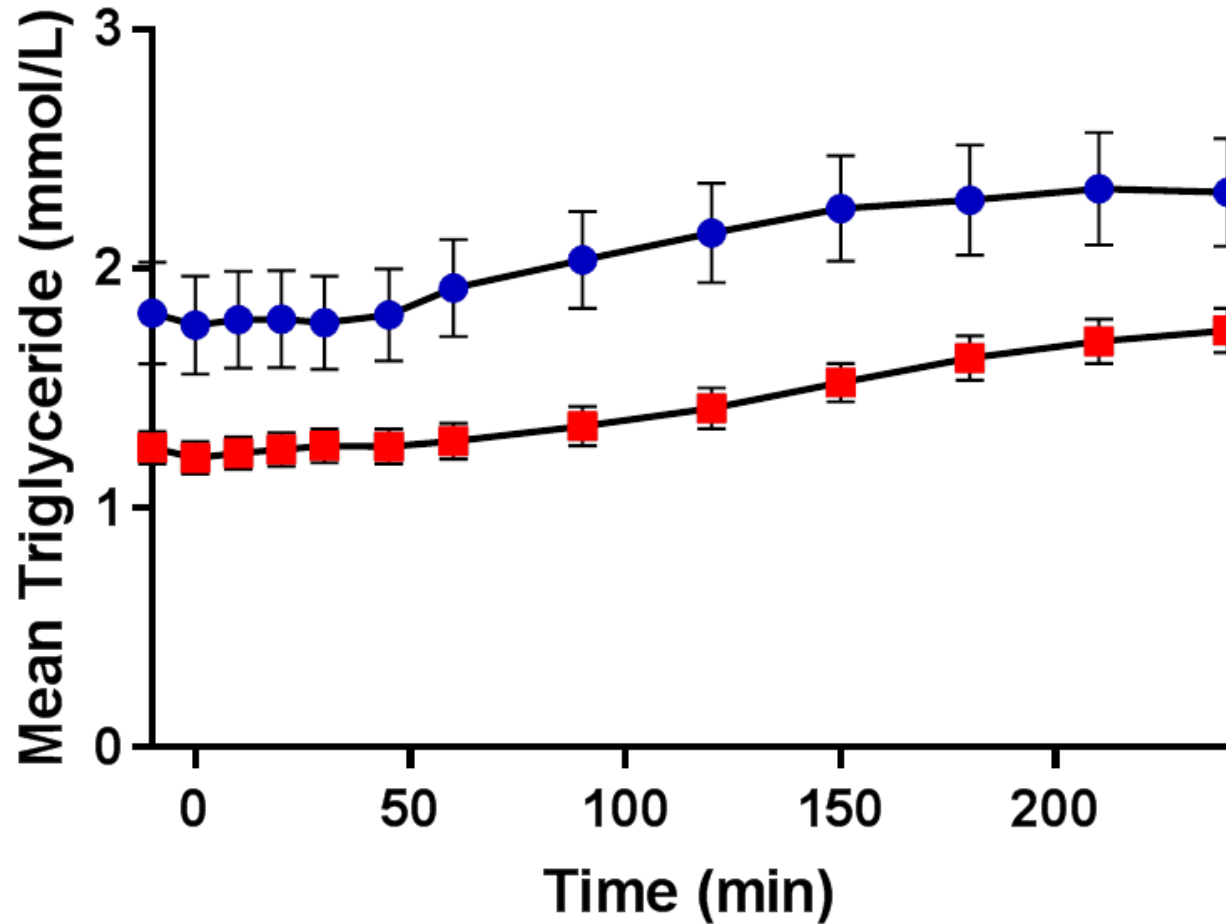
NEFA

13.6% reduction in postprandial NEFA AUC



Mixed meal test – Mean plasma triglyceride

30.3% reduction in postprandial TG AUC



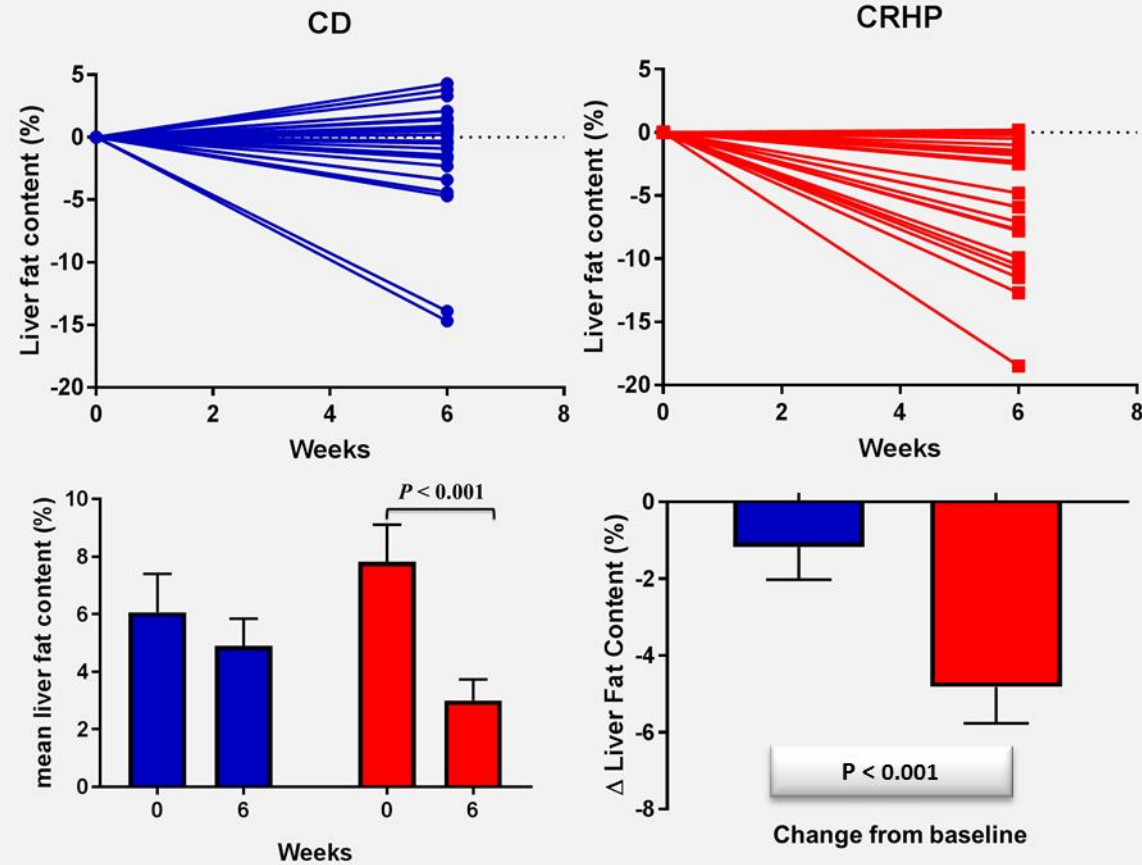
A**Liver MR spectroscopy**

Fig A: Change in liver fat content after 6 weeks of CD and CRHP diets respectively. A significant reduction from baseline was found after 6 weeks of CRHP diet. No significant reduction was found after 6 weeks of diet. The reduction was significantly larger after 6 weeks on the CRHP diet compared with 6 weeks on the CD diet.

To evaluate the effects of 6-week modest weight loss induced by a **CRHP** diet in individuals with T2D and overweight or obesity...

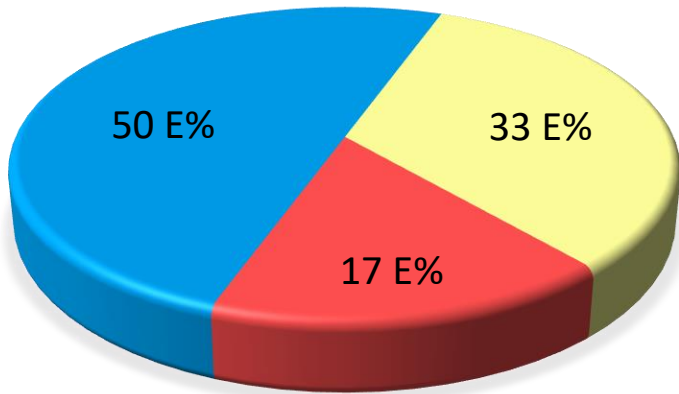
- Compared with the same amount of weight loss induced by a **CD** diet
- Tailoring of energy intake and fixed weight loss
- Dissecting effect of carbohydrate-restriction from weight loss
- In a highly controlled setting of full food provision
- Independently of other confounding lifestyle modification

Diet intervention

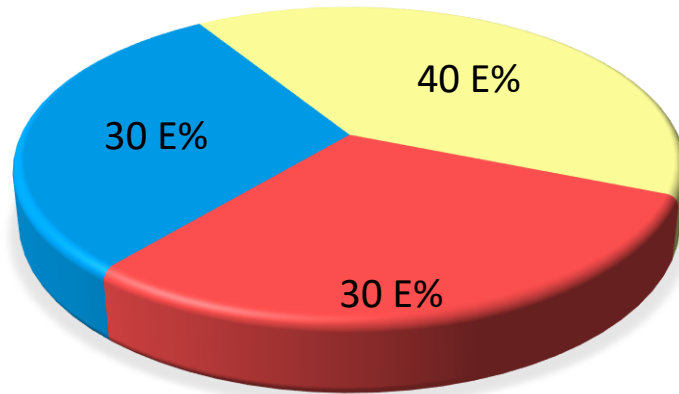
Methodology

REGION

- Carbohydrate
- Protein
- Fat



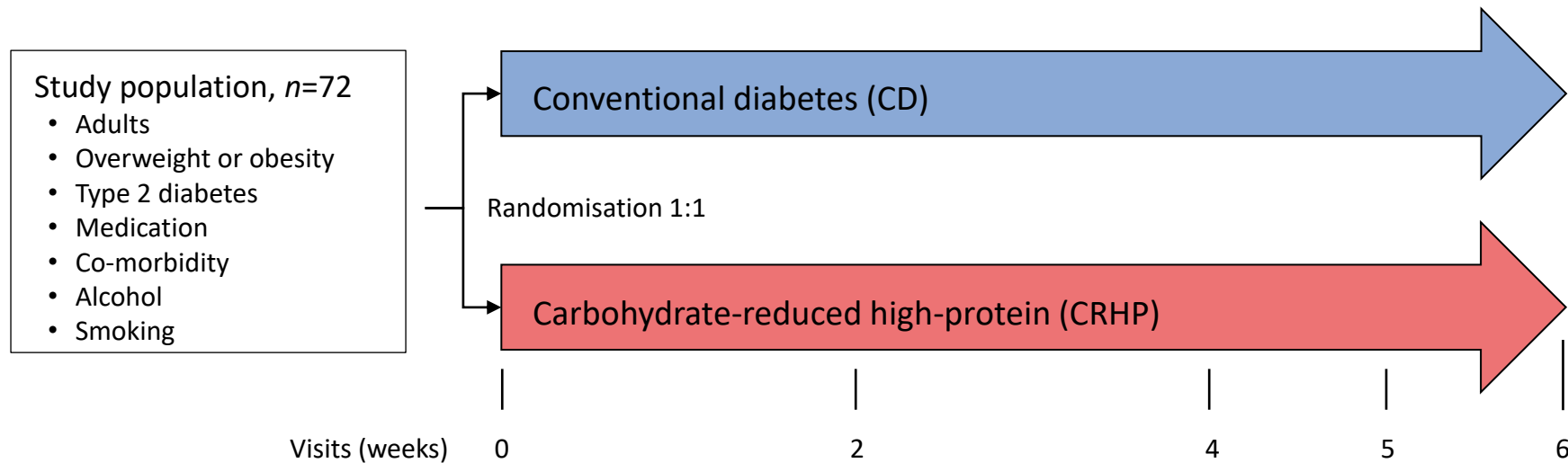
CD DIET



CRHP DIET



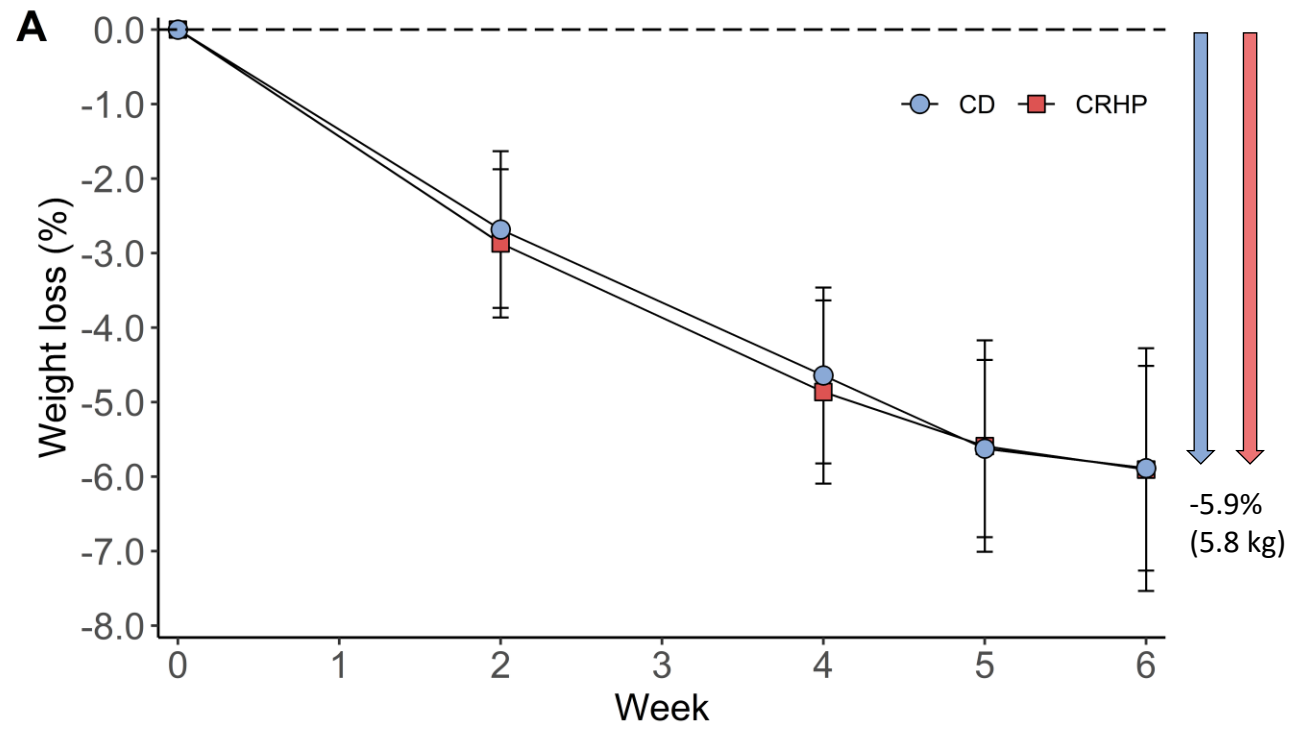
Open-label randomised clinical trial



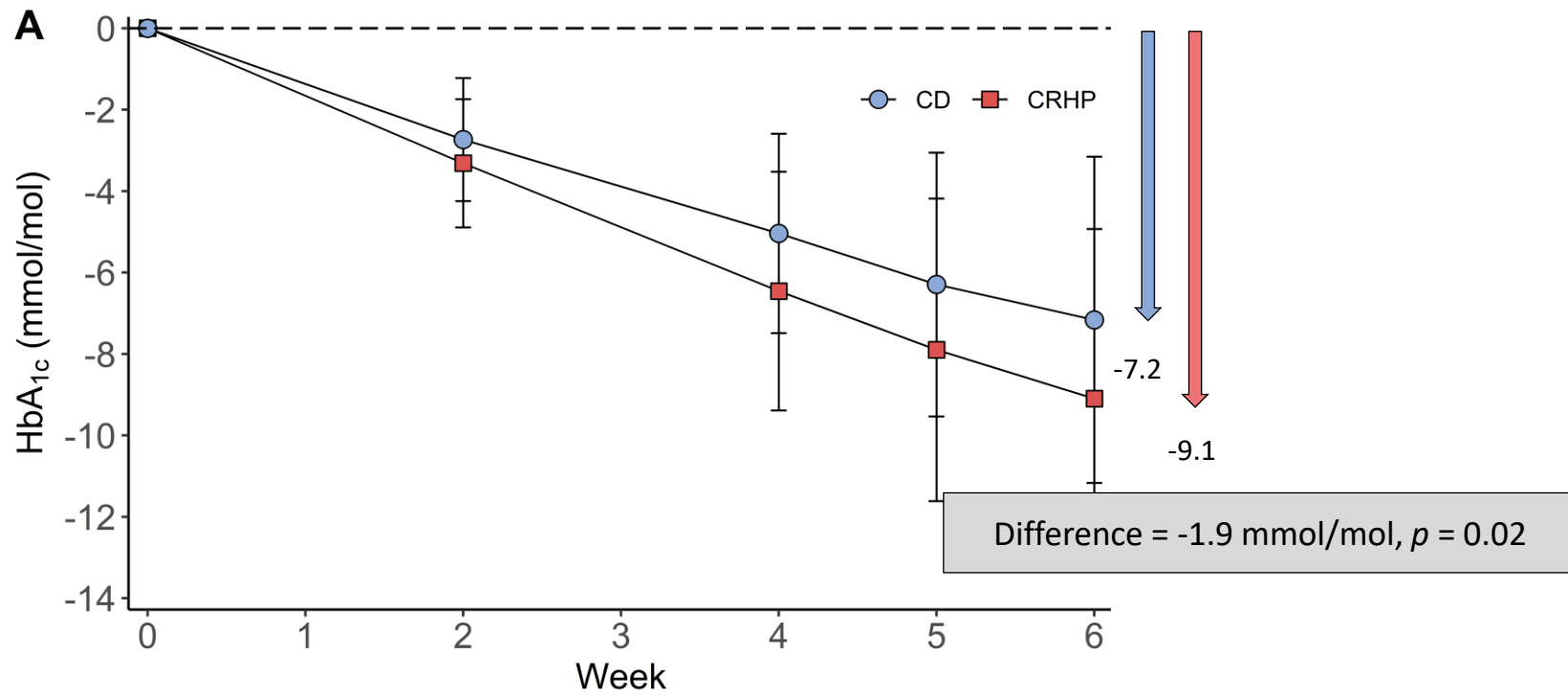
No change in physical activity level

No change in medication

Relative changes in body weight



HbA_{1c}

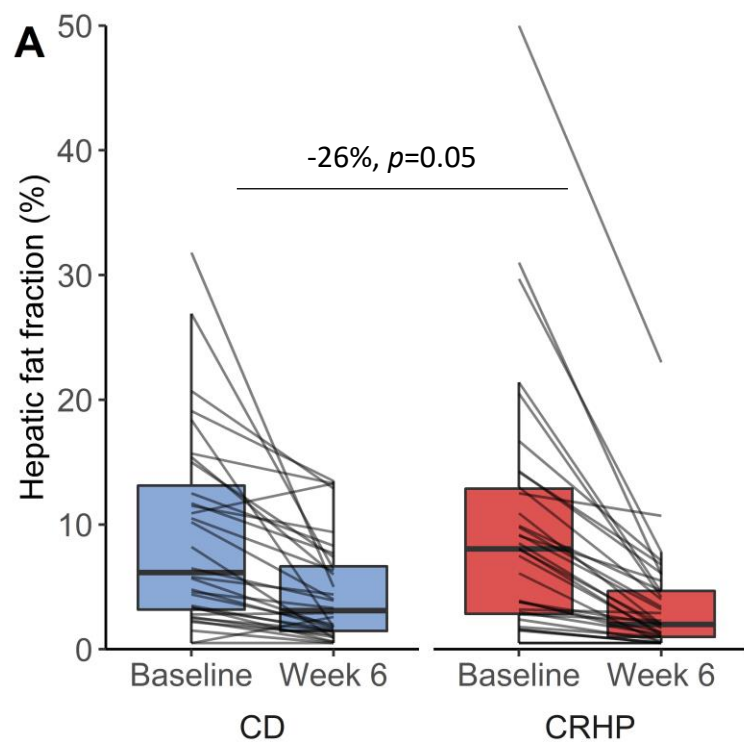


Ectopic fat accumulation

Intrahepatic fat → Steatosis cut-off 5.6%¹ (31 excluded)

Intrapancreatic fat

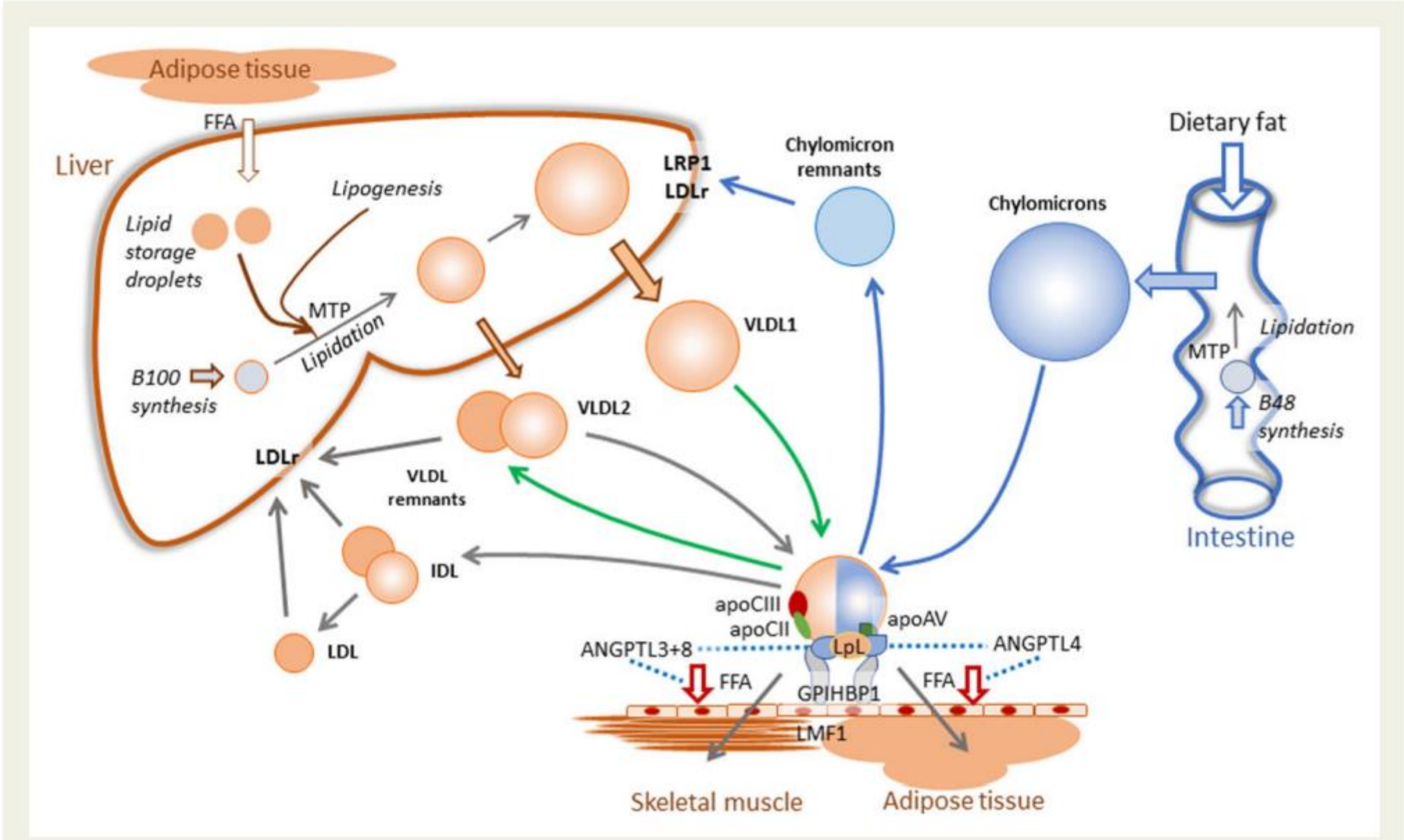
Intramuscular fat



-28%, $p=0.03$

-35%, $p=0.04$





Conclusions

With or without weight loss a **CRHP** diet compared with a **CD** diet in patients with T2D and overweight or obesity...

Glucometabolic control

- Reduced HbA_{1c}, 24-h mean glucose, and glycaemic variability

Lipid metabolism

- Reduced intrahepatic fat
- Reduced fasting blood triglyceride and free fatty acids and improved the atherogenic profile of lipoproteins

Safety

- Did not affect renal function
- Caused no negative effects on cognitive function
- Increased time below range, episodes of CGM-determined hypoglycaemia

Perspectives

Proof-of-concept of metabolic benefits of carbohydrate restriction

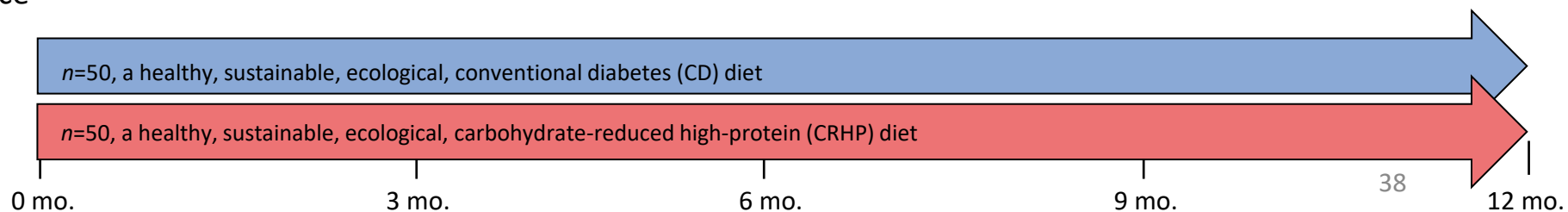
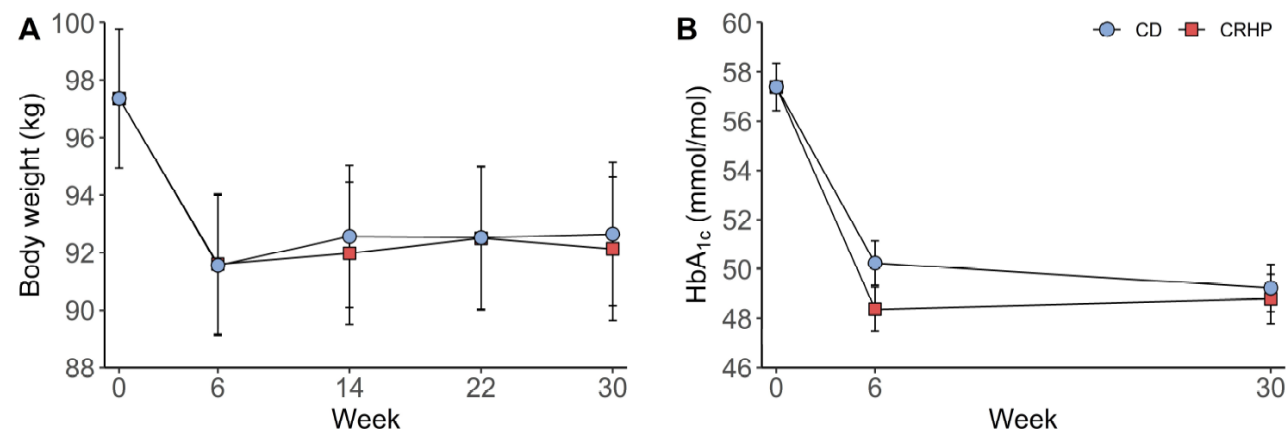


Changes in dietary recommendations

- Long-term feasibility
- Long-term efficacy
- Long-term safety

How to implement a carbohydrate-restricted eating plan

- Supporting food provision
- Supporting dietician guidance



CutDM | Måltidskassestudiet

Reduktion af kulhydrat i diabeteskosten – Måltidskassestudiet

Et lodtræknings-forsøg

Institutions



Forskningssted

Endokrinologisk Afdeling, Bispebjerg Hospital

Bispebjerg Bakke 23

2400 København, Danmark



**Bispebjerg
Hospital**

Måltidskasserne

- Udviklet af diætist Luise Persson Kopp, Trine Bech Klindt og Skagen Food
- Opskrifterne er testede, og der vil være mulighed for eventuelle løbende justeringer
- Sunde og bæredygtige fødevarer
- Morgen-, mellem- og aftensmåltider udleveres
- 3 energitrin ud fra et estimeret dagligt energibehov
- Mængden af mad leveret forventes at overstige det reelle behov
- Partnere vil få mulighed for at tilkøbe samme måltidskasse. Af hensyn til forsøget vil det være en måltidskasse med samme energitrin som forsøgsdeltageren.

