

ERNÆRINGSFOKUSKONFERENCEN 2024

STUDIET CUT-DM:

INDSIGTER I PATOGENESE –
ERFARINGER FRA DIÆT- OG ERNÆRINGSBEHANDLINGEN

THURE KRARUP

Professor, overlæge, dr.med

7. NOVEMBER 2024

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UNIVERSITY OF
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FACULTY OF HEALTH AND
MEDICAL SCIENCES
UNIVERSITY OF COPENHAGEN



**Bispebjerg og Frederiksberg
Hospital**

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

Obesity (BMI ≥ 30 kg/m²)

O
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Diabetes

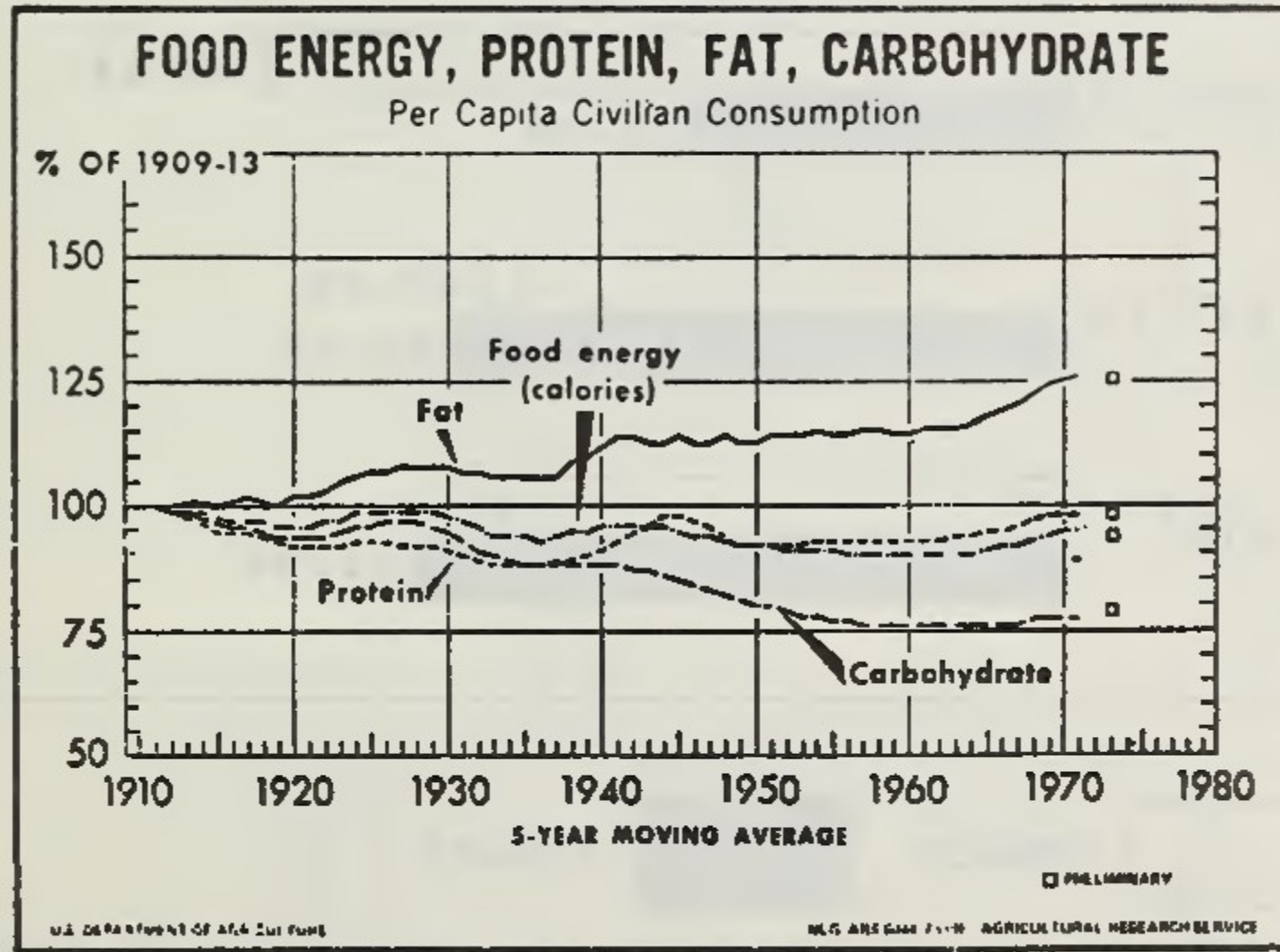
D
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CDC's Division of Diabetes Translation. National Diabetes Surveillance System available at <http://www.cdc.gov/diabetes/statistics>



FIGURE 2



Source: "Changes in Nutrients in the U.S. Diet Caused by Alterations in Food Intake Patterns," B. Friend, Agricultural Research Service, U.S. Department of Agriculture.

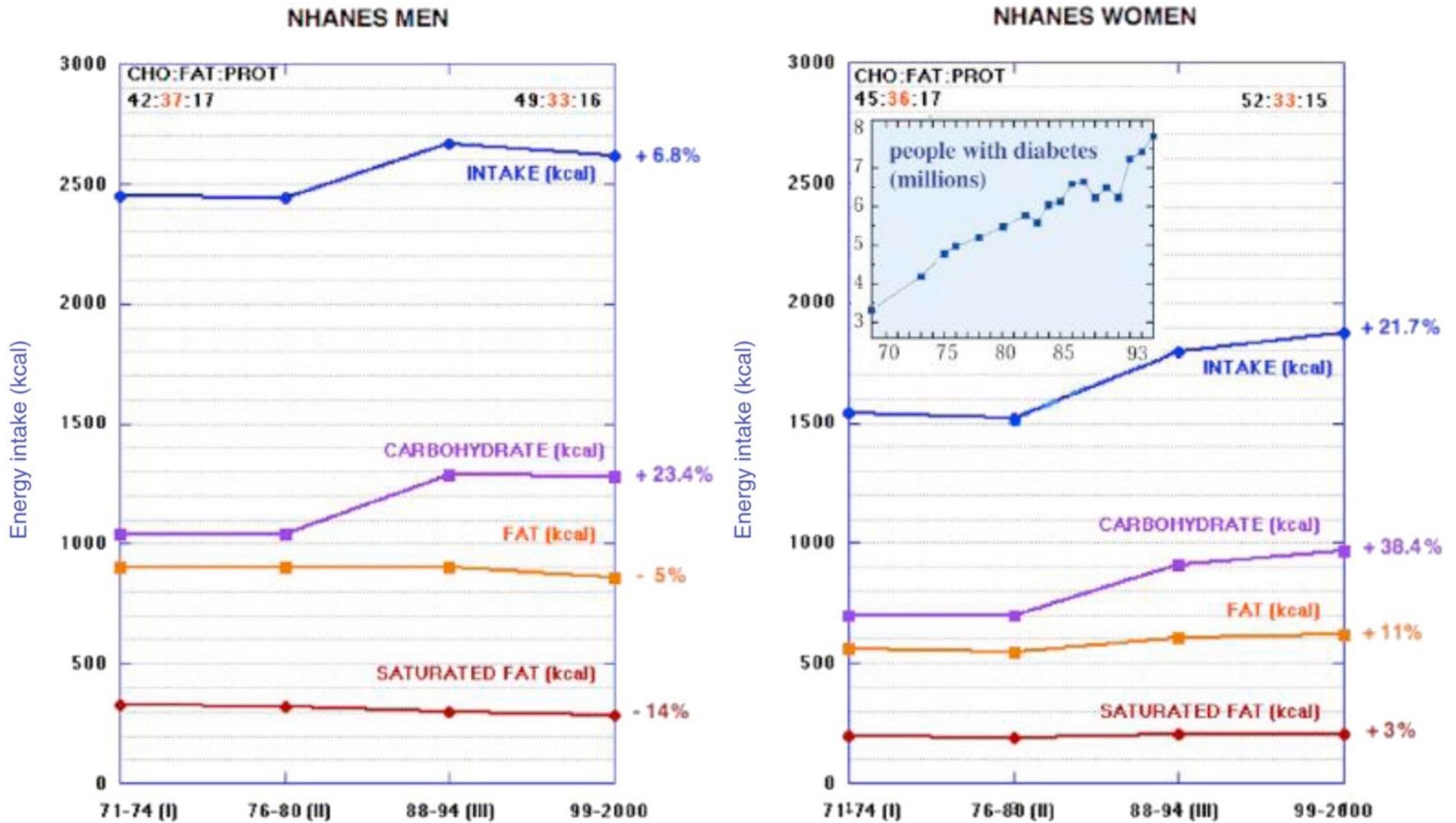


Fig. 2. Macronutrient consumption during the epidemic of obesity and type 2 diabetes. Data from the [National Health and Nutrition Examination Survey](#) (NHANES) by year, and from [Centers for Disease Control and Prevention](#) [*Centers for Disease Control and Prevention Trends in intake of energy and macronutrients—United States, 1971 to 2000, MMWR Morb Mortal Wkly Rep, 53 (2004), pp. 80-82*]. Inset: Incidence of diabetes (millions of people with diabetes by indicated year). Data from [L.S. Gross, L. Li, E.S. Ford, S. Liu, *Increased consumption of refined carbohydrates and the epidemic of type 2 diabetes in the United States: an ecologic assessment. Am J Clin Nutr, 79 (2004), pp. 774-779*]. CHO, carbohydrate; Prot, protein. From Feinman RD, Pogozelski WK, Astrup A, Bernstein RK, Fine EJ, Westman EC, m.fl. Dietary carbohydrate restriction as the first approach in diabetes management: Critical review and evidence base. *Nutrition*. januar 2015;31(1):1–13.

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.

Medical Technology Evaluation 2003

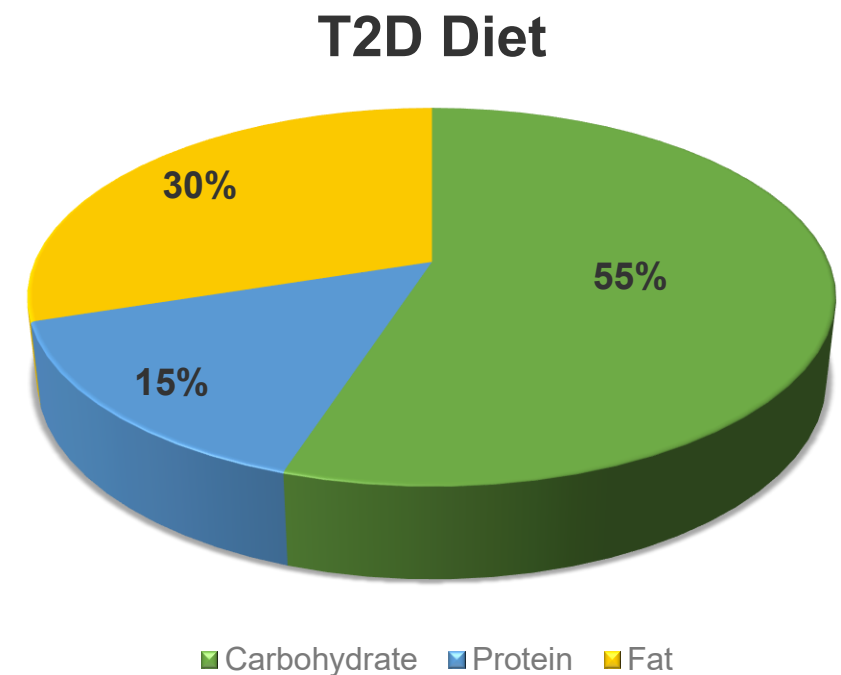
NON-PHARMACOLOGICAL TREATMENT OF TYPE 2 DIABETES

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

Carbohydrates and T2D

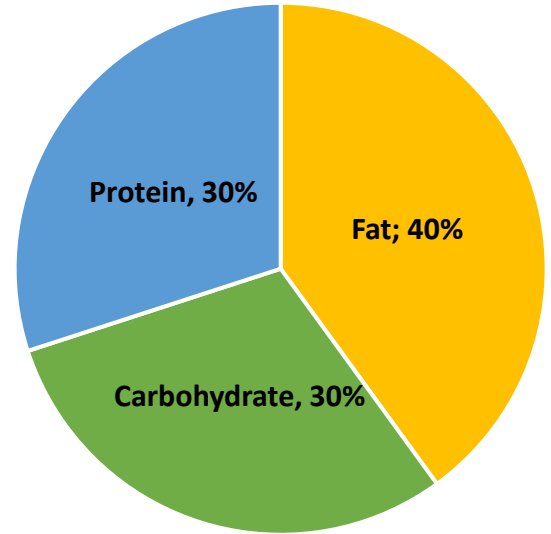
Diabetes Nutrition Study Group 2005

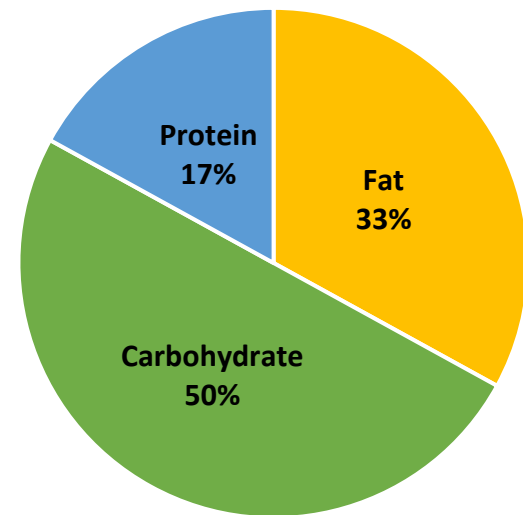
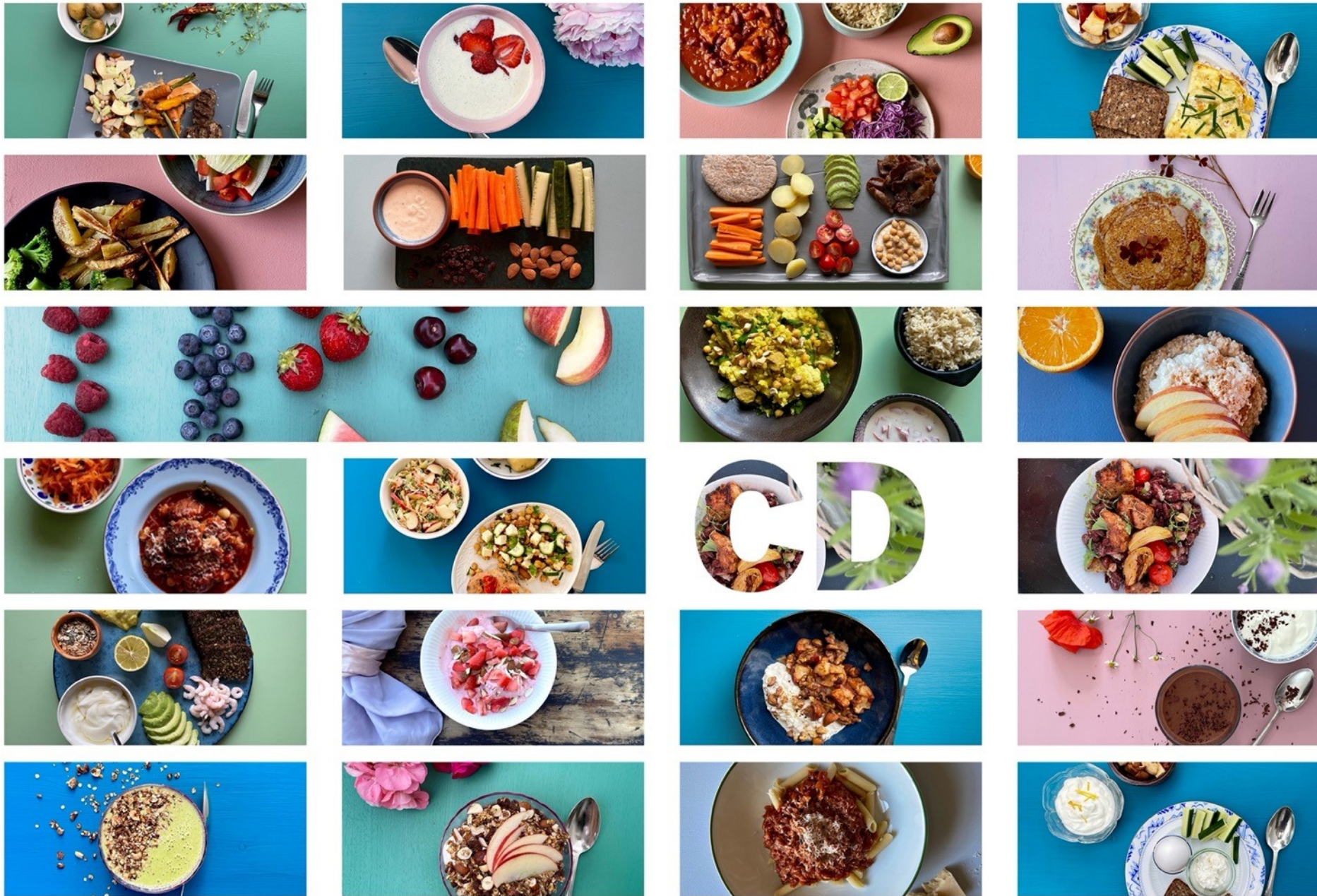
- The reason for a high carbohydrate diet is a simple calculation:
- Fat (30 E%), Protein (15 E%)
- The remainder = 55 E% carbohydrate!





CRHP





Macronutrient composition and quality of a CD and a CRHP diet

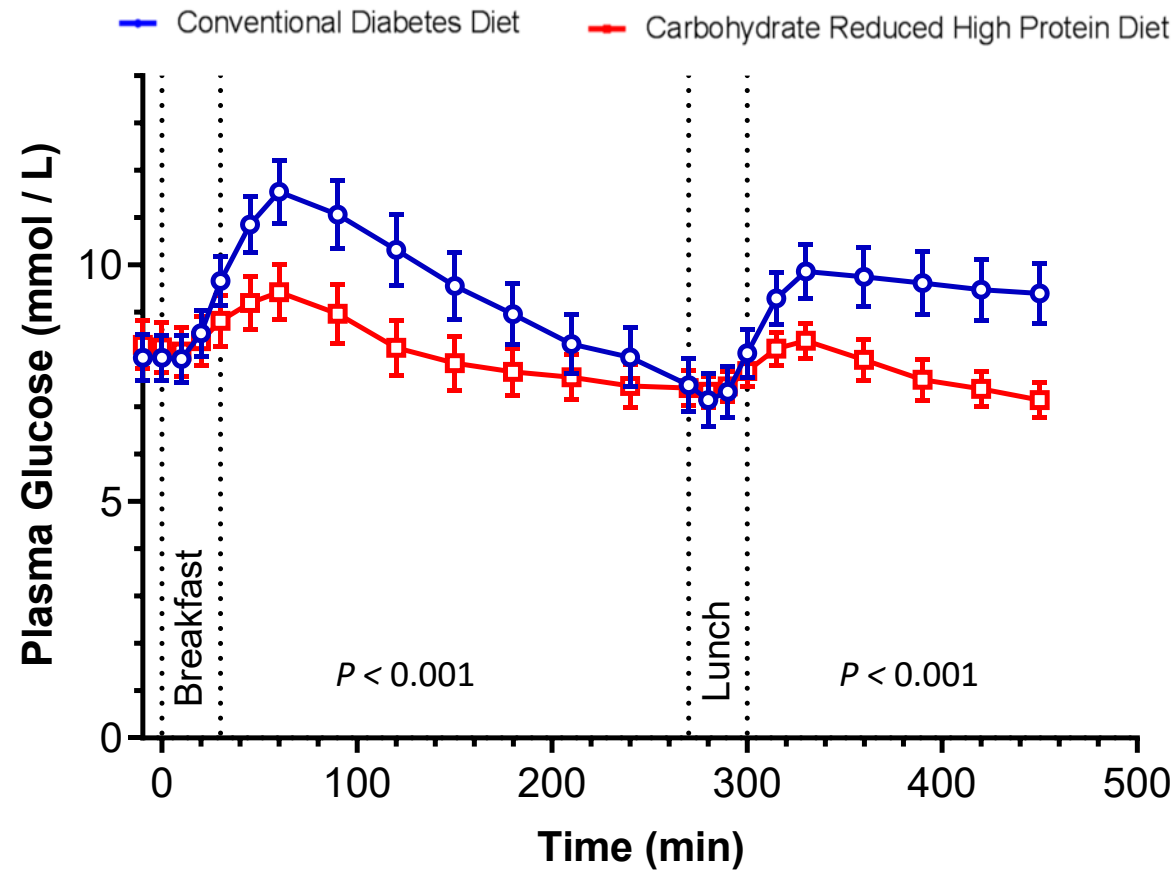
Macronutrient	CD diet	CRHP diet
Carbohydrate, total	50 (48-52) E%	30 (28-32) E%
Dietary fibre	Min 2.0 g / MJ	Min 2.0 g / MJ
Added sugar	Max 8 E%	Max 5 E%
Protein, total	17 (16-19) E%	30 (28-32) E%
Fat, total	33 (31-35) E%	40 (38-42) E%
Saturated and trans fatty acids	Max 10 E%	Max 13 E%
Monounsaturated fatty acids	10-15 E%	10-20 E%
Polyunsaturated fatty acids	5-15 E%	5-15 E%

Dietary requirements of a daily CD or CRHP diet. For carbohydrate, protein, and fat each meal had to be ± 2 E% of the targeted energy percent (E%)

CutDM – four studies

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

Mixed meal test – Glucose

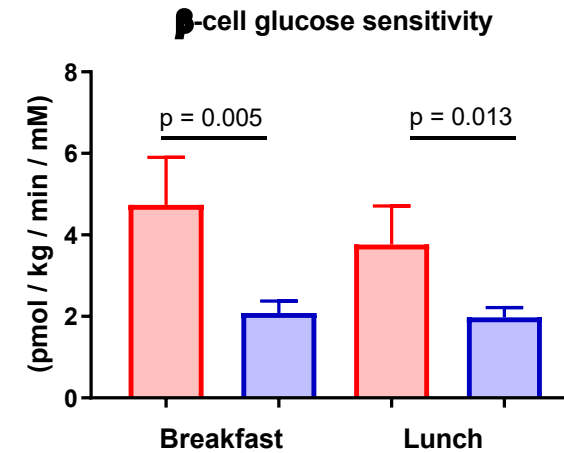
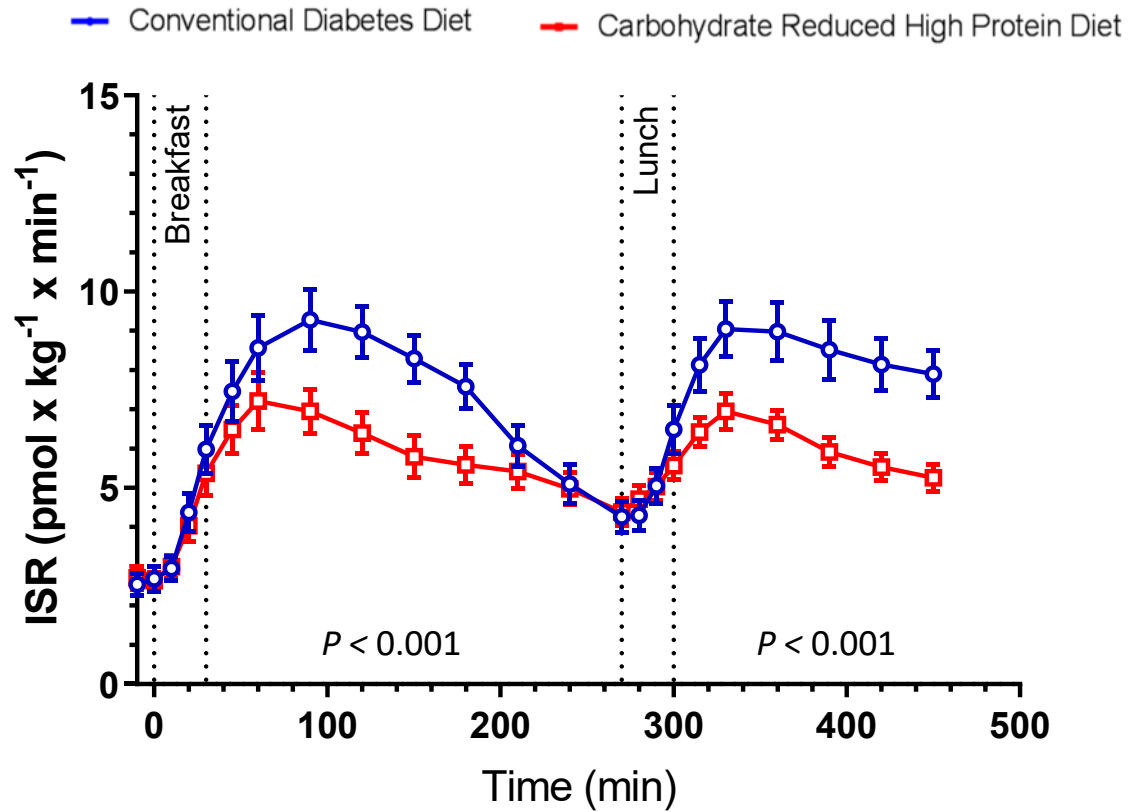


Peak glucose was reduced by 18% following breakfast and by 15% following lunch

Second-meal effect was observed on both diets

14% reduction in postprandial glucose

Mixed meal test – ISR and β -cell glucose sensitivity



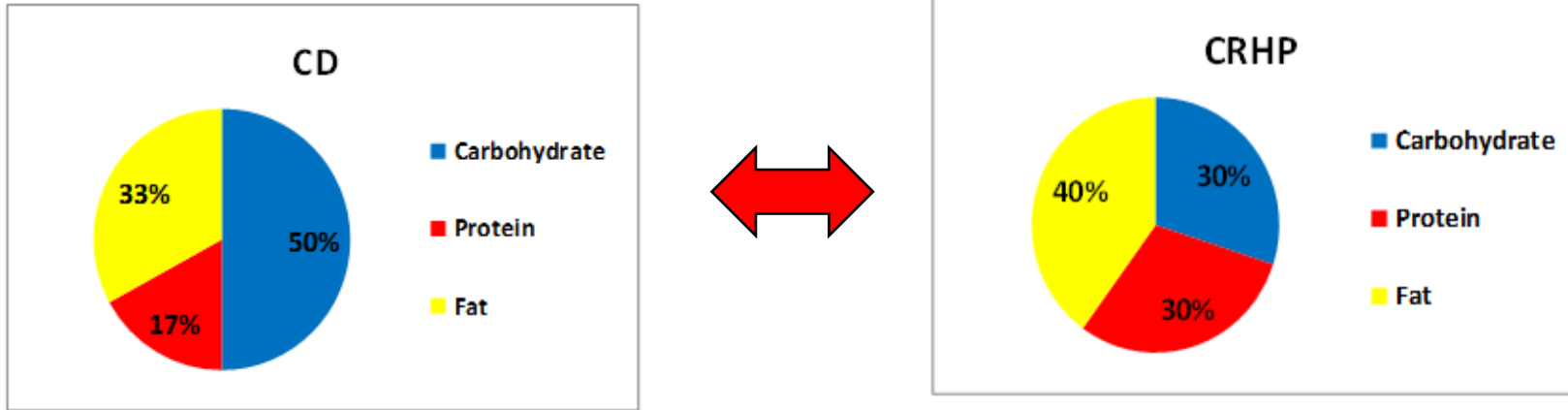
May be due to deteriorated incretin effect¹ but maintained protein-stimulated insulin secretion in type 2 diabetes²

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

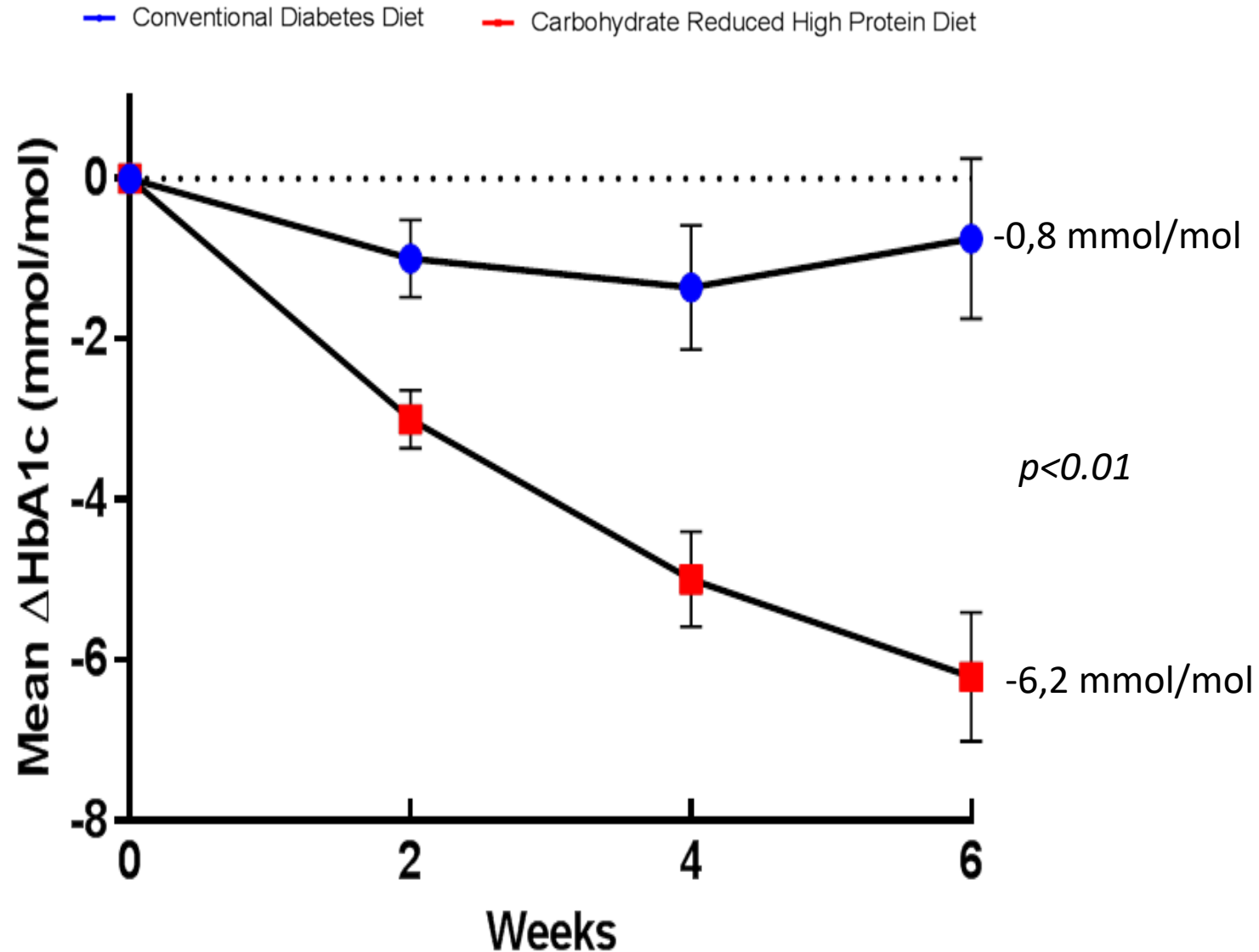
CutDM - The Isoenergetic Study



Aim

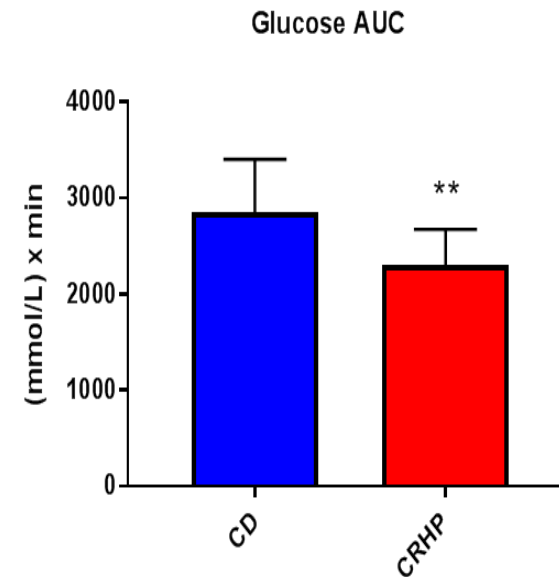
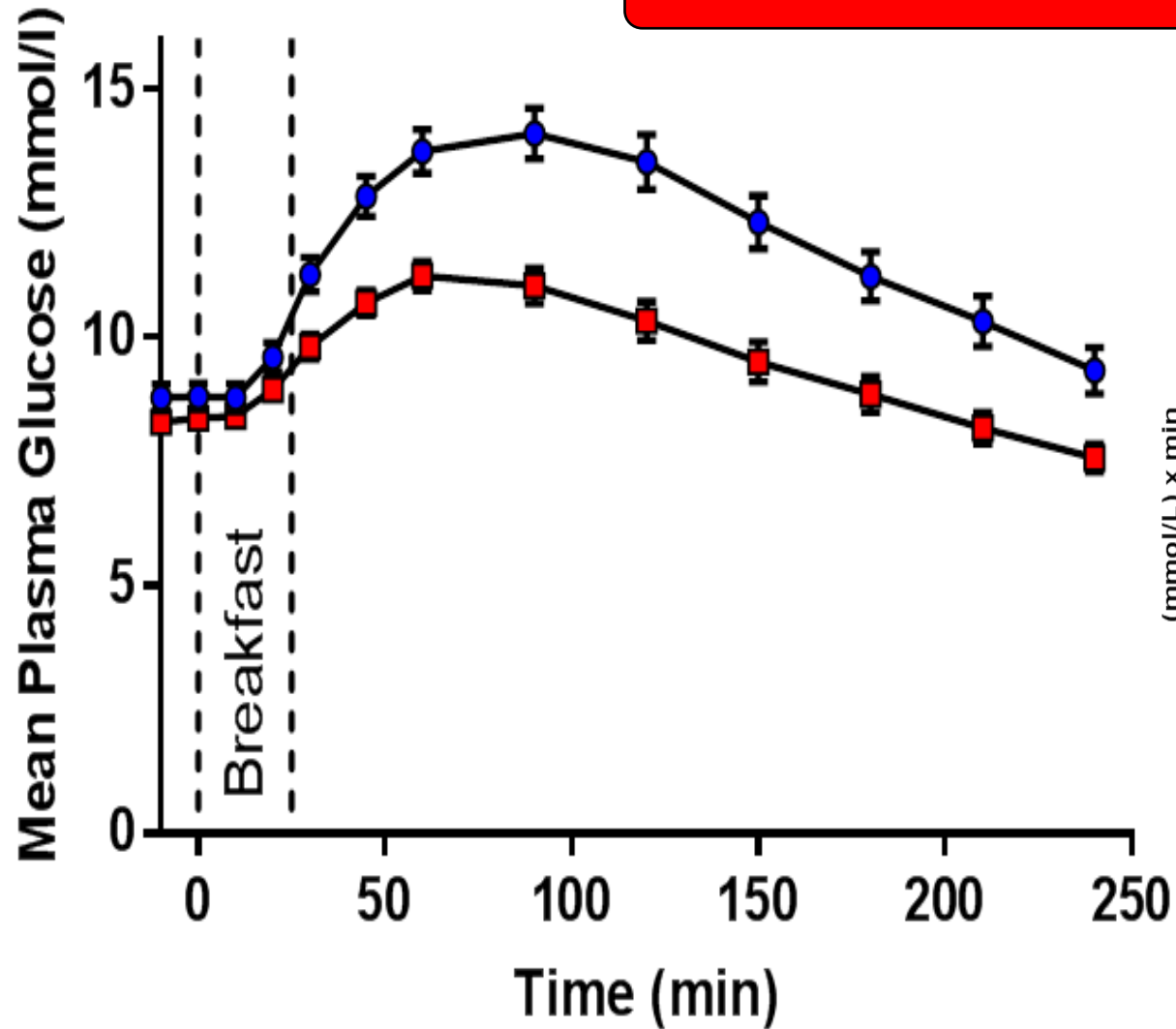
To examine the effect of a CRHP diet compared to a CD diet over 6 weeks without weight loss.

Change in HbA1c during 6 weeks of intervention



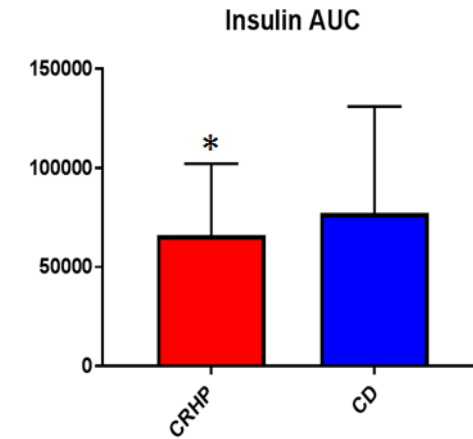
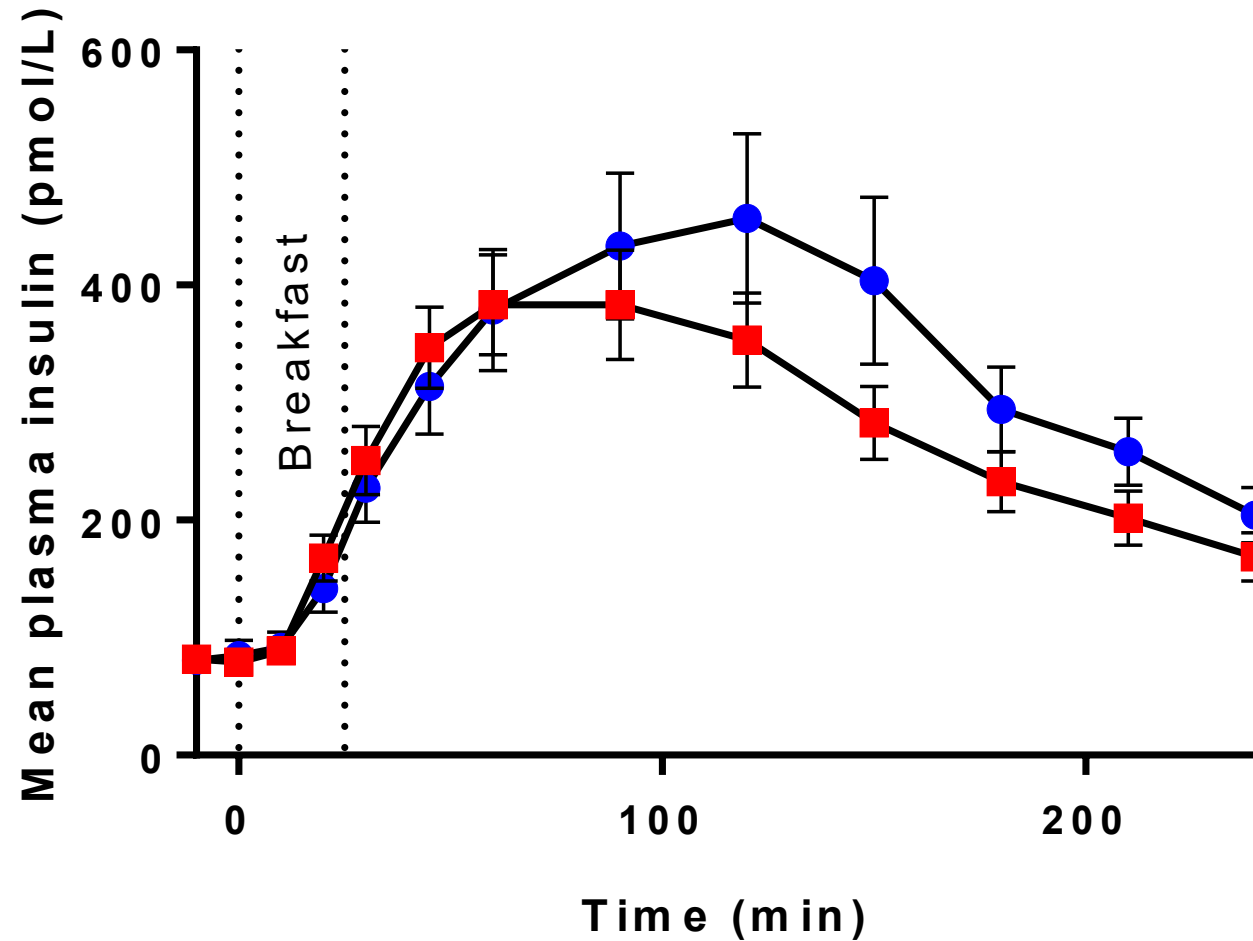
Mixed meal test – Mean plasma glucose

19% reduction in postprandial plasma glucose AUC



Mixed meal test – Mean plasma insulin

14.5% reduction in postprandial insulin AUC



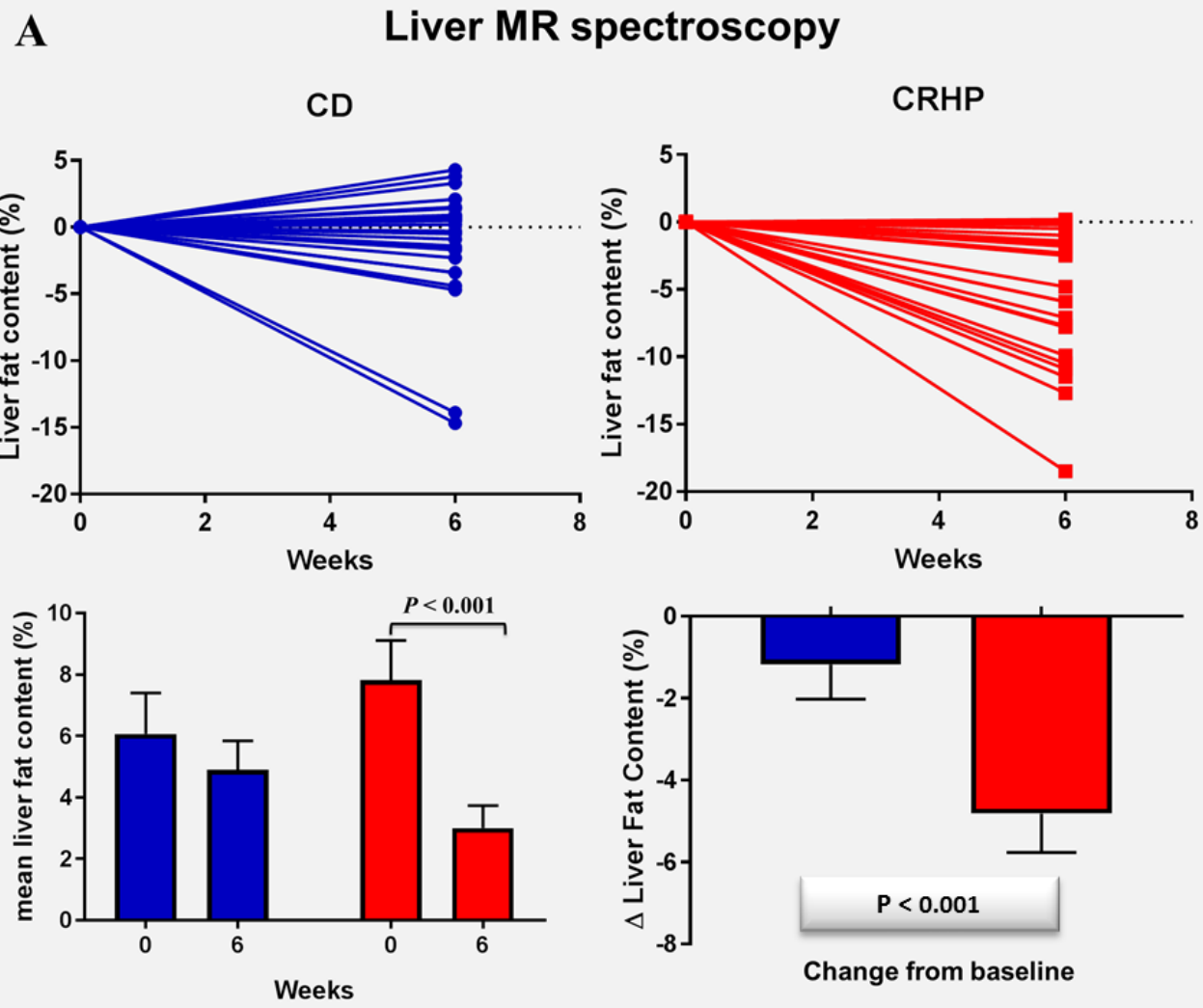


Fig A: Change in liver fat content after 6 weeks of CD and CRHP diets respectively. A significant reduction from baseline was found after 6 weeks of CRHP diet. No significant reduction was found after 6 weeks of diet. The reduction was significantly larger after 6 weeks on the CRHP diet compared with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

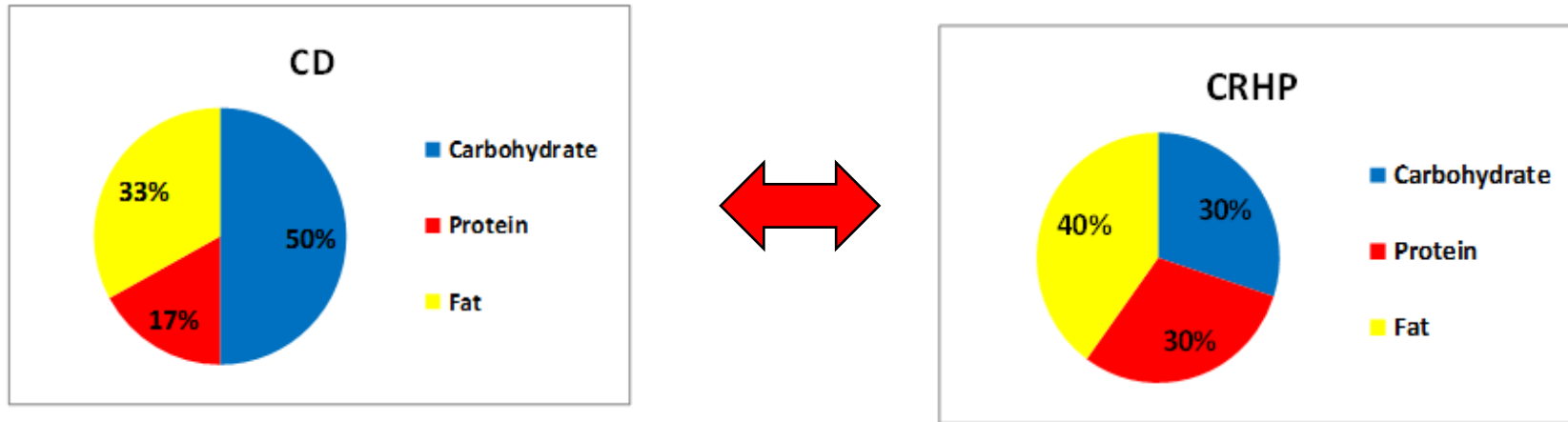
Carbohydrate Reduction and Beta-cell function

- Fasting intact proinsulin and 32,33 split proinsulin concentrations (both absolute and relative to C-peptide) were reduced
- Insulinogenic index and Beta-cell sensitivity to glucose improved by 31% and 45%
- Glucose excursions were reduced (TIR)

Conclusion

A CRHP diet reduced glucose excursions and improved beta-cell function including proinsulin processing in individuals with type 2 diabetes mellitus

CutDM - The Hypoenergetic Study

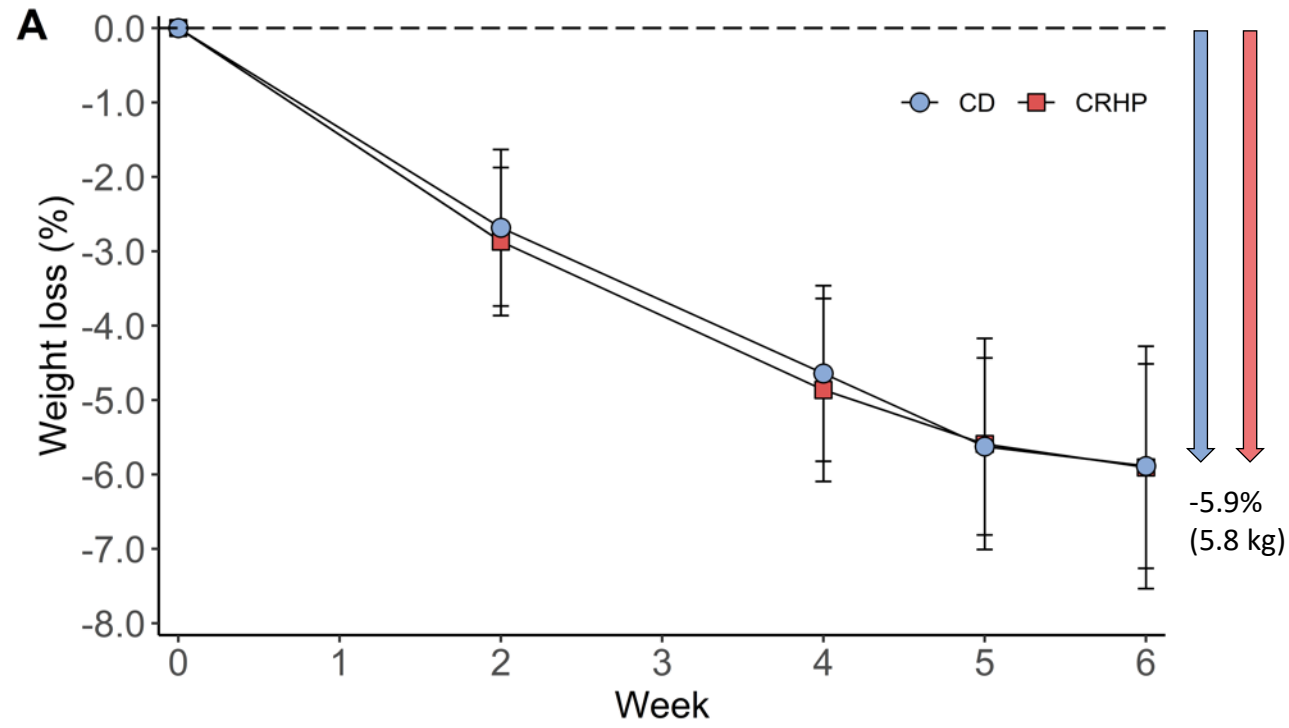


Aim

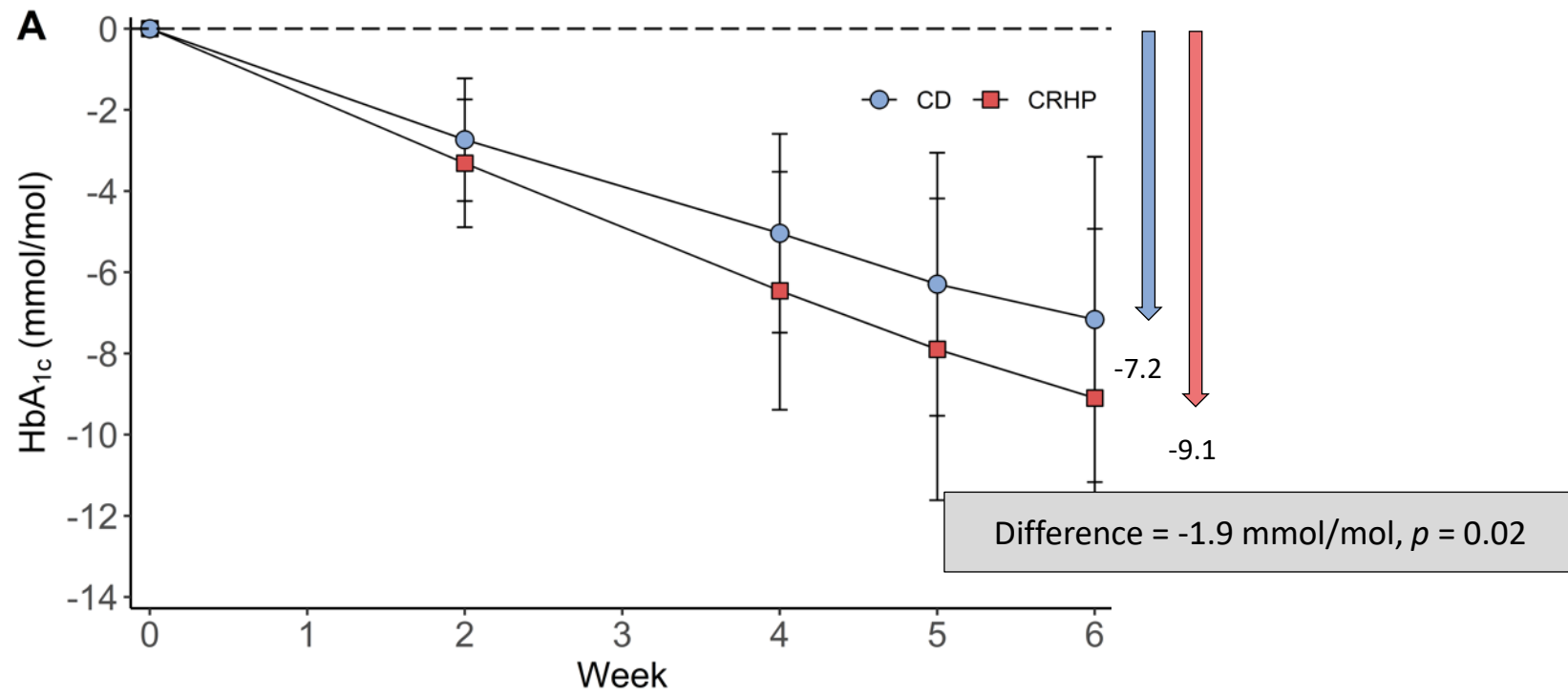
To examine the effect of a CRHP diet compared to a CD diet over 6 weeks with an adjusted weight loss.

Body weight

Relative changes in body weight



HbA_{1c}

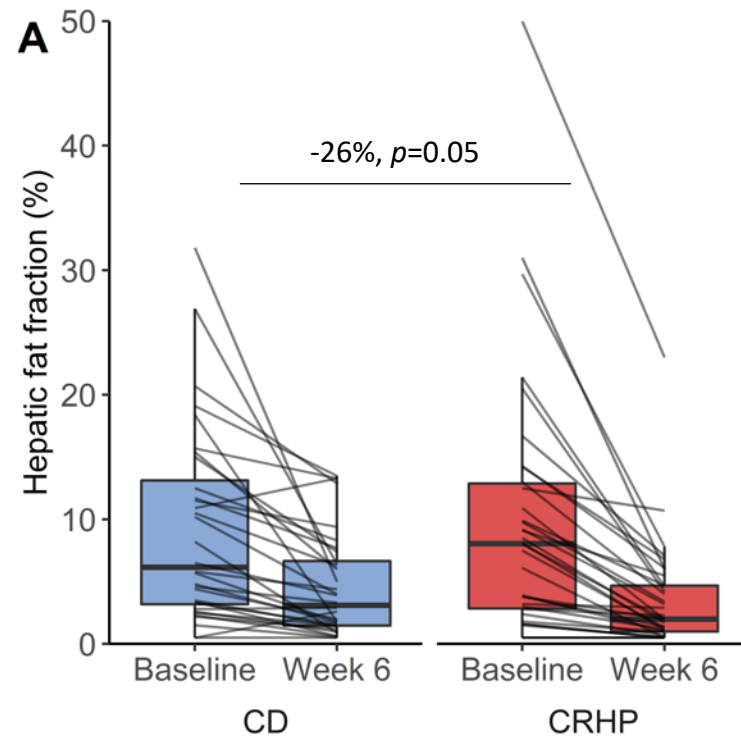


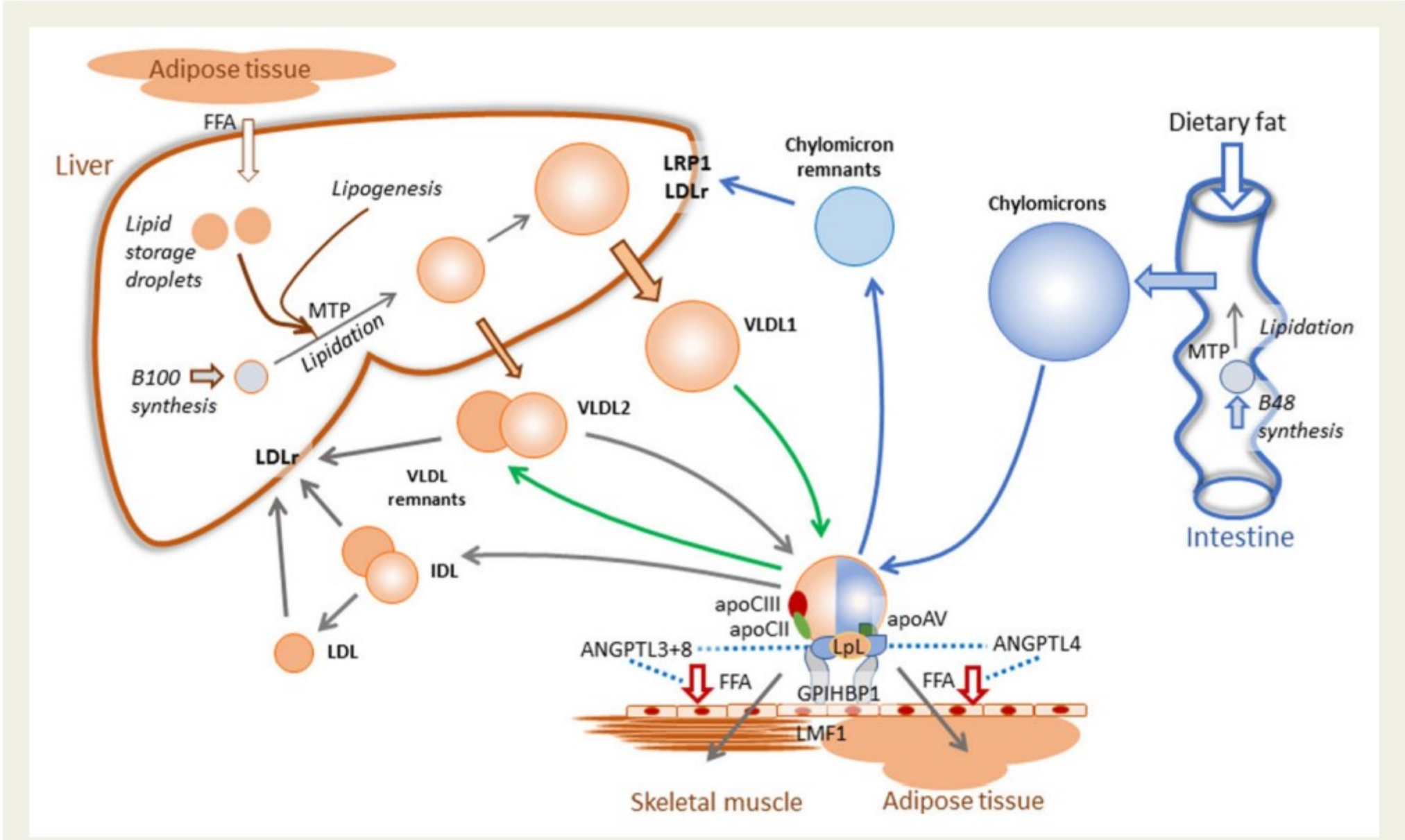
Ectopic fat accumulation

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

Intrapancreatic fat

Intramuscular fat





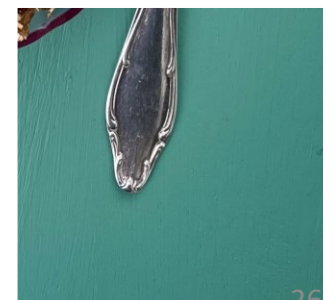
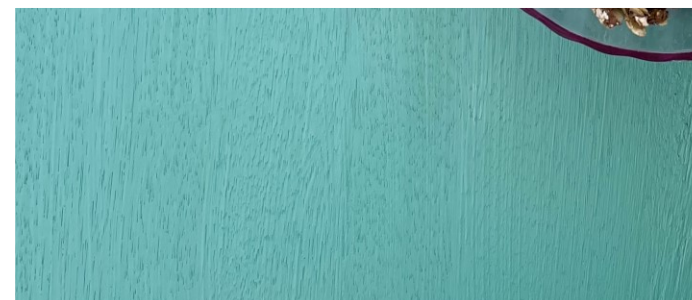
SARCOPENIA

Age-associated decline in skeletal muscle mass and function with increased risk of falls, disability, and mortality aggravated in type 2 DM

Requires approximately up to 60% more protein than hitherto recommended to oppose the decline and increase muscle protein synthesis

Summary CutDM

- **A CRHP diet compared to the traditionally recommended CD diet will over a 6-week period:**
- Lower HbA1c independent of weight loss
- Reduce glucose excursions- Increases Time In Range (TIR)
- Improve beta-cell function
- Decrease liver fat
- Reduce atherogenic lipids - Leading to less arteriosclerosis
- Reduce antidiabetic medicine
- Increased E% of protein may reduce sarcopenia
- Give dieticians evidence-based suggestions for a diabetic diet



So why do we even need more studies?

- Long term effect of carbohydrate-reduced diets remains to be determined – Long duration studies are few and inconclusive
- Hypothesis:
The diminishing effects are likely a result of inadequate adherence to the Carbohydrate-reduced diets.
- Solution:
To introduce new dietary treatment principles that improve long-term adherence to the studied diets. (I.e. possibly Meal kits)





CutDM I The Meal Kit Study

Reduction of carbohydrates in the diabetes diet

A randomized controlled trial

Institutions



KØBENHAVNS
UNIVERSITET



Forskningssted

Endokrinologisk Afdeling, Bispebjerg Hospital

Bispebjerg Bakke 23

2400 København, Danmark



**Bispebjerg
Hospital**

Purpose of The Meal Kit Study

Aim

To investigate the effects of a CRHP diet compared with a CD diet, provided as a meal kit delivery service for 12 months in a free-living setting in individuals with T2D

We hypothesize that glucometabolic benefits can be achieved following 12 months of carbohydrate-restricted dieting, by maximizing dietary adherence through delivery of meal kits, containing fresh, high-quality ingredients for breakfast, dinner, and snacks, combined with nutrition education and counselling.

Primary outcome: *Change in HbA1c between baseline and 12 months*

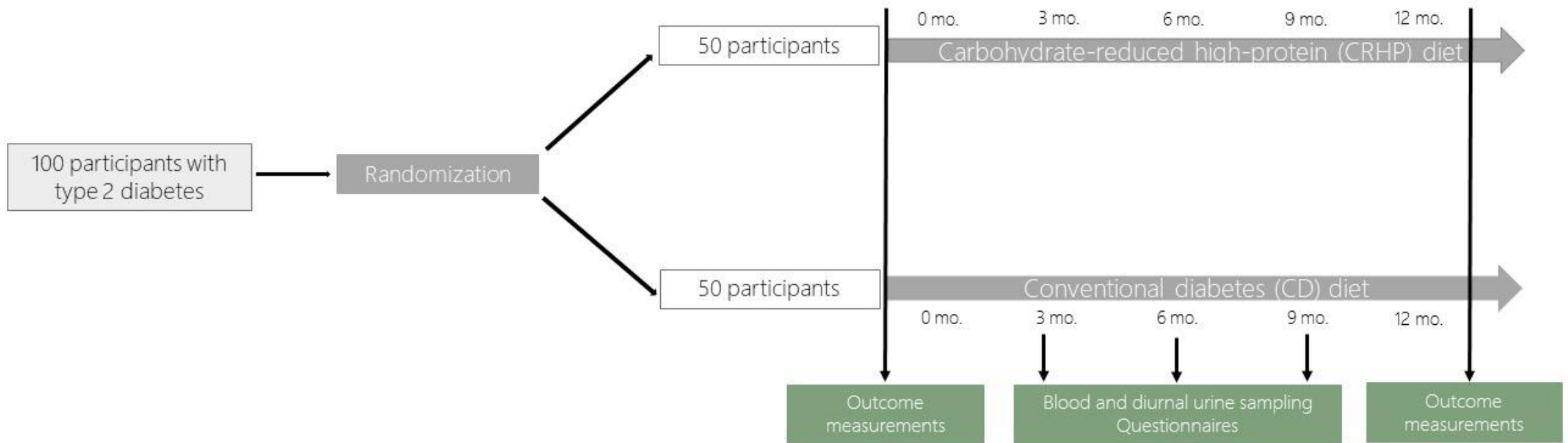
Secondary outcomes:

- *Changes in body weight*
- *Changes in liver fat content (measured by MRI scan)*

The Meal-kits

- Developed by PhD-student and clinical dietitian Luise Persson Kopp, clinical dietitian Trine Bech Klindt, chefs with Meal Kit expertise in collaboration with Skagenfood A/S.
- The recipes have been tested, and there is opportunity for ongoing adjustments, as well as changes due to seasonal variations.
- Two daily main meals: breakfast and dinner, and 1-2 snacks daily are provided via Meal Kits for 12 months.
- Eucaloric diets, provided free-of-charge for 12 months, cover more than 2/3 of the total individual estimated daily energy requirements for body weight maintenance (~20% for breakfast, ~35% for dinner, and ~10% for snacks).
- To allow for options and flexibility, participants will be responsible for lunch (~35% of total daily energy intake), while still required to adhere to the macronutrient distribution.
- Lunch and dinner can be interchanged if deemed necessary, e.g., when going out for dinner, further enhancing adaptability of the diet to daily life.
- Adherence to the allocated diets will be reinforced by monthly sessions of nutrition education and counselling from registered clinical dietitians.

Study design



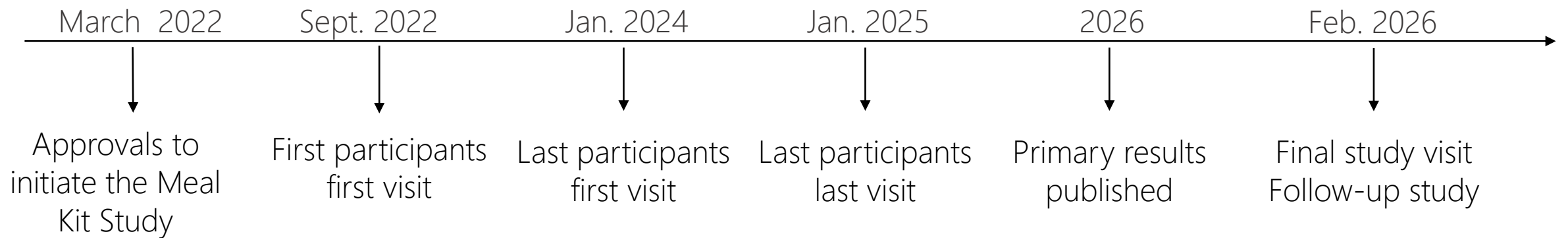
- Adult men or postmenopausal women <76 years,
- diagnosed with T2D with an HbA_{1c} level of 48-75 mmol/mol,
- and a body mass index (BMI) >25 kg/m²

Living conditions for participants

- Unchanged medication (if deemed safe)
- Unchanged physical activity level
- Ad libitum dieting by changeable serving sizes and individual needs and preferences
- NO weight loss requirement ie no calorie restriction
- Culturally appropriate substitutes for specific ingredients are made available with ethnic groups in mind, although optional for all participants.
- Preparation and cooking methods are optional, provided that all ingredients are used, making the meals adjustable for different lifestyles and individual preferences
- Alcoholic beverages are permitted within the recommendations from the Danish Health Authorities, still taking the calorie and carbohydrate content into consideration

Timeline

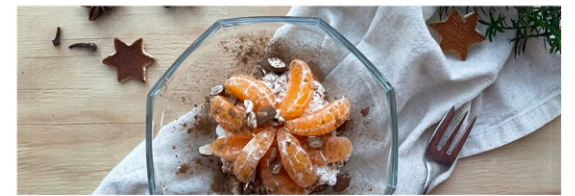
The Meal Kit Study and Follow-up





MÅLTIDSKASSESTUDIET

Luise Persson Kopp, klinisk diætist, ph.d.-studerende,
Endokrinologisk forskningsafdeling, Bispebjerg Hospital





KORT OM *Måltidskassestudiets koncept*

En alsidig og
bæredygtig kost

Måltidskasser

- Måltidskasse-setuppet lærer deltagerne både at spise sundt, men også klima-venligt, hvor det vil hjælpe dem med at træffe de rette valg.

Mejeriprodukter

- Mejeriprodukter med et højt proteinindhold er oplagte valg i en diæt med et højere protein- og lavere kulhydratindhold og vil derfor naturligt indgå i en kost til personer med type 2-diabetes.

Rigtig mad

- Diæterne fremhæver vigtigheden og betydningen af rigtig mad – uforarbejdede, naturlige råvarer, herunder næringsrige mejeriprodukter der bidrager med vigtige mineraler og vitaminer.

Kostanbefalinger

- De anbefalede diæter er næringstætte og består af velkendte fødevarer og retter, der understøtter madtraditioner og kulturel accept.

Mine observationer og erfaringer

- En varieret kost baseret på primært uforarbejdede råvarer; det helt simple er lige så godt som det komplekse
- Sammensætningen af makronæringsstoffer til hvert måltid gør en stor forskel
- Måltidsmønsteret er (for de fleste) virkelig vigtigt
 - At sikre et stabilt og sufficient energiindtag fra morgenstunden er afgørende, for at undgå "kage-monsteret" eller "trætheds-monsteret" om eftermiddagen



Tanker fra vores deltagere

"Fysisk har jeg oplevet store forbedringer [...] Derudover er mine maveproblemer forsvundet, hvilket har gjort en enorm forskel for mit velbefindende. På det psykiske plan har ændringen også haft en stor indvirkning – jeg føler mig mere glad og fuld af energi, hvilket smitter af på min hverdag og mit humør."

Mit bedste råd til andre er: Det vigtigste er at holde fast og huske på, hvorfor du gerne vil ændre noget. Når du først mærker de positive resultater – som bedre helbred og mere energi – vil det blive lettere at fortsætte.

"hvis jeg for 20 år siden bare havde vidst det her om kosten og havde fået din vejledning, så så alting meget anderledes ud. Ja, måske jeg så ikke engang havde fået diabetes"

"ja, min kone har jo været efter mig, at vi skulle tilbage til opskrifterne igen – så nu er det hver dag igen"

Der er mange omveje og bump på livets vej



Og hvad så nu?

- Resultater er endnu ikke offentliggjort – de første data bliver behandlet i februar 2025 😊
- Tænk fordeling ved hvert måltid – og vær ikke bekymret for at spise ”nok” fra morgenstunden – det kan være afgørende for din dag 😊
- Diætister GØR en forskel 😊



Tak for opmærksomheden –
spørgsmål?
