糖胖症的最佳飲食為何?

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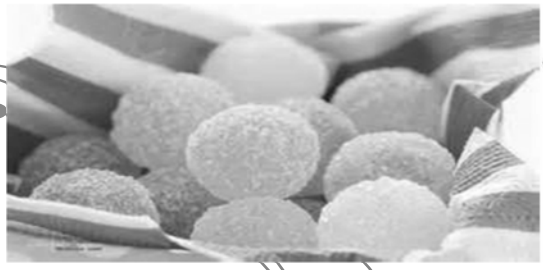
糖胖症

Diabesity = diabetes + obesity



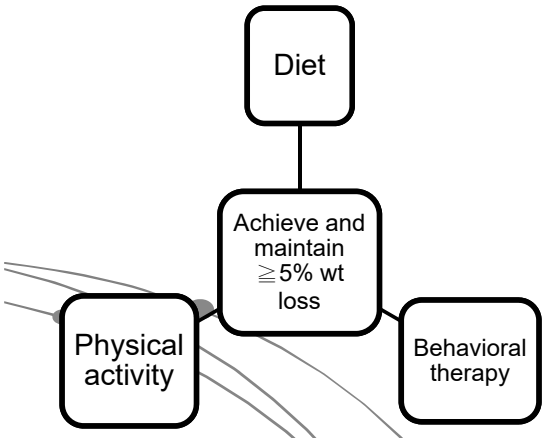
ADA

Obesity Management for the Treatment of Type 2 Diabetes: Standards of Medical Care in Diabetes-2020

- Obesity management
  - Prediabetes: 延緩進展到第2型糖尿病的進程
  - Type 2 DM: 有助於疾病的控制，包含改善血糖與降低用藥需求

- 有些小型研究顯示肥胖的第2型糖尿病人，在沒有使用藥物的情況下，使用VLCD可以降低 A1C 至 <6.5% (48 mmol/mol) ，空腹血糖降至< 126 mg/dL (7.0 mmol/L)

Diabetes Care, 2020; 43, suppl 1, s89-s97.



achieve a 500–750kcal/day energy deficit

1. 高強度介入策略(≧ 16 sessions in 6 months)
2. 評估個人動機、生活環境、改變意願
3. 飲食計畫需個別化
4. 考慮影響飲食型態的食物可近性與文化特性
5. 短期目標達成後可考慮長期體重維持的計畫並強化個人管理的策略

Diabetes Care, 2020; 43, suppl 1, s89-s97.

體重過重及肥胖的第2型糖尿病人治療策略

Table 8.1—Treatment options for overweight and obesity in type 2 diabetes

	BMI category (kg/m^2)		
Treatment	25.0–26.9 (or 23.0–24.9*)	27.0–29.9 (or 25.0–27.4*)	≥30.0 (or ≥27.5*)
Diet, physical activity, and behavioral therapy	†	†	†
Pharmacotherapy		†	†
Metabolic surgery			†

*Recommended cut points for Asian American individuals (expert opinion). †Treatment may be indicated for select motivated patients.

Diabetes Care, 2020; 43, suppl 1, s89-s97.

糖胖症的處理策略

- Whichever mode of management of obesity and diabetes is preferred, diet and physical activity are the cornerstones of treatment.
- Low CHO/low fat/ high protein diet can be enormously helpful

Primary Care Diabetes. 2010; 4, 105-112.

- Weight reduction is a central pillar of management.
- Calorie redistribution, apart from calorie restriction, is an important part of nutritional therapy in diabesity.

J Pak Med Assoc. 2013; 63, 532-534.

糖胖症的飲食策略

The US Diabetes Prevention Program (DPP)

- Weight reduction ≧7%
- Low cal, low fat foods
- Moderate physical activity

Diabetes, Obesity and Metabolism. 2010; 12, 463-473.

Diets in the management of diabesity

- Low CHO diet
- Low fat diet
- Low glycemic diet
- Mediterranean diet

Glucose Intake and Utilization in Pre-Diabetes and Diabetes. 2014; Chapter 2, p 21–28.

ADA consensus report

A variety of eating patterns (combinations of different foods or food groups) are acceptable for the management of diabetes.

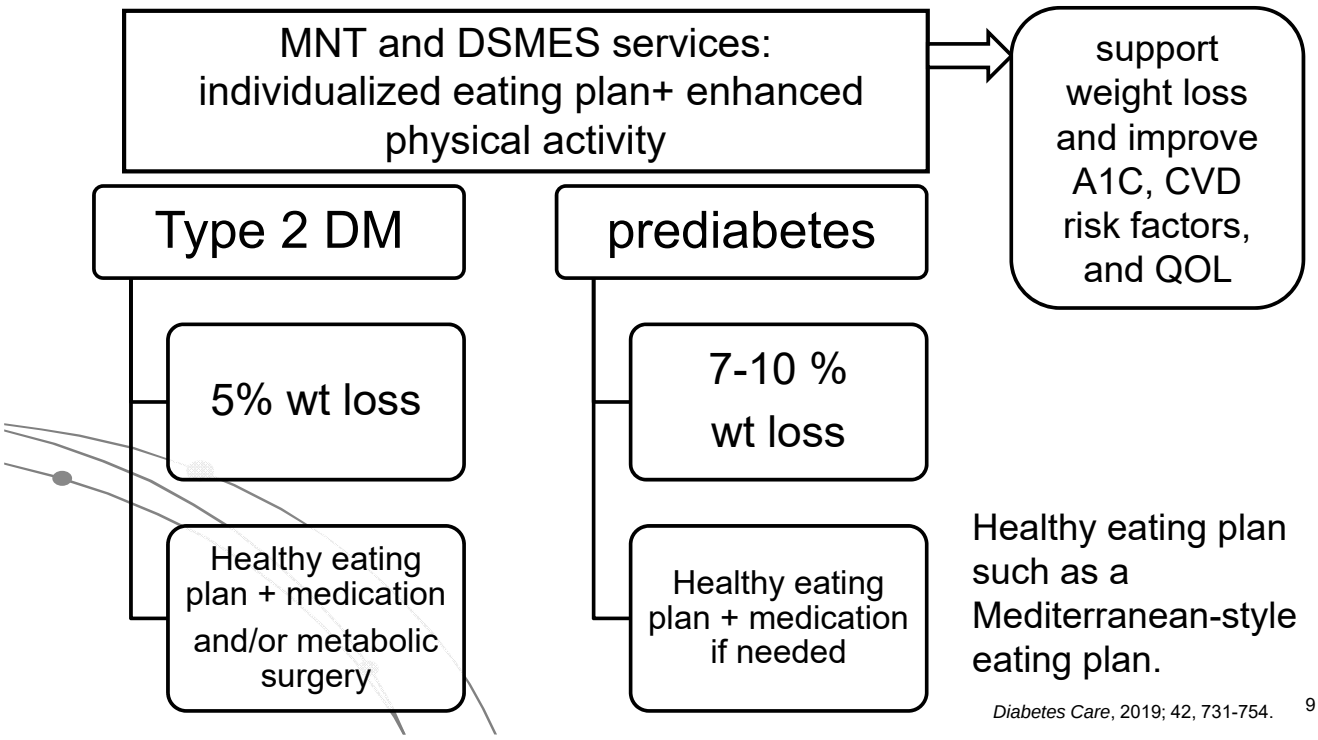
Health care providers should focus on the key :

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 antiglycemic medications is a priority, reducing overall CHO intake with low- or very low carbohydrate eating plans is a viable approach.

Diabetes Care, 2019; 42, 731-754.



Diabetes Care, 2019; 42, 731-754.

成人肥胖防治實證指引(國健署, 2018)

建議等級	臨床建議內容	章節
1A	為達減重目的，負能量平衡是必要的，許多飲食方案皆可降低熱量攝取。建議營養師應考慮個案個人與家庭飲食喜好、接受度、肥胖程度、健康與營養狀況，以做出個人化、可持久的飲食介入處方。 (強建議，證據等級高)	7-1
1B	建議減少含糖飲料攝取。在無代償性增加其他食物攝取下，應可減少體重。 (強建議，證據等級中)	7-2-1
1B	原本有使用代糖飲品習慣者，不需強制改喝白開水，代糖飲料並不會破壞減重成效。建議可依個案喜好或遵循力，以水或代糖飲料取代含糖飲料。 (強建議，證據等級中)	7-2-1
2A	極低熱量飲食(VLCD) 在短期減重效果顯著，但長期因易出現復胖現象，使其減重效果與低熱量飲食(LCD) 相當。雖減重成效快速，但持續性則不如低熱量飲食。 (弱建議，證據等級高)	7-2-2
1A	低熱量飲食減重時，使用代餐的效果比飲食份量控制法佳。但對於減重或體重的維持管理，兩種方法都有效。 (強建議，證據等級高)	7-2-2

成人肥胖防治實證指引(國健署, 2018)

建議等級	臨床建議內容	章節
1B	第2 型糖尿病的肥胖病人採用「份量控制餐盤」法6 個月後，大部分可降低體重，並減少降血糖藥的使用。建議在日常生活中，可採用此種方法以減少熱量攝取。 (強建議，證據等級低)	7-2-2
2A	生酮飲食或極低熱量飲食(VLCD) 短期內可以在醫護人員及營養師的監督下達到效果，但不可以做為長期的飲食營養介入方式。 (弱建議，證據等級高)	7-2-3
2B	採用間歇性熱量限制法可達到減重效果，可降低體脂肪，效果與每天低熱量飲食法相當。 (弱建議，證據等級中)	7-2-4
2B	飲食頻率和降低體脂肪率之間呈現正相關；但是在熱量控制下，進行少量多餐，對於減重並無顯著效果。 (弱建議，證據等級中)	7-2-4
1B	雖然隨機試驗顯示有沒有吃早餐的減重效果是一樣的，但考量不吃早餐和體重過重還是呈現正相關，建議減重時每日仍須要吃早餐。 (強建議，證據等級中)	7-2-4

ADA reviewed-1

Type of eating pattern	**Potential benefits reported**
USDA Dietary Guidelines For Americans (DGA)	DGA added to the table for reference; not reviewed as part of this Consensus Report
Mediterranean-style	• Reduced risk of diabetes • A1C reduction • Lowered triglycerides • Reduced risk of major cardiovascular events
Vegetarian or vegan	• Reduced risk of diabetes • A1C reduction • Weight loss • Lowered LDL-C and non–HDL-C
Low-fat	• Reduced risk of diabetes • Weight loss
Very low-fat	• Weight loss • Lowered blood pressure

ADA reviewed-2

Type of eating pattern	Potential benefits reported
Low-carbohydrate	• A1C reduction • Weight loss • Lowered blood pressure • Increased HDL-C and lowered Triglyceride
Very low-carbohydrate (VLC)	• A1C reduction • Weight loss • Lowered blood pressure • Increased HDL-C and lowered triglycerides
Dietary Approaches to Stop Hypertension (DASH)	• Reduced risk of diabetes • Weight loss • Lowered blood pressure
Paleo	• Mixed results • Inconclusive evidence

Diabetes Care, 2019; 42, 731-754.

Palaeolithic diet

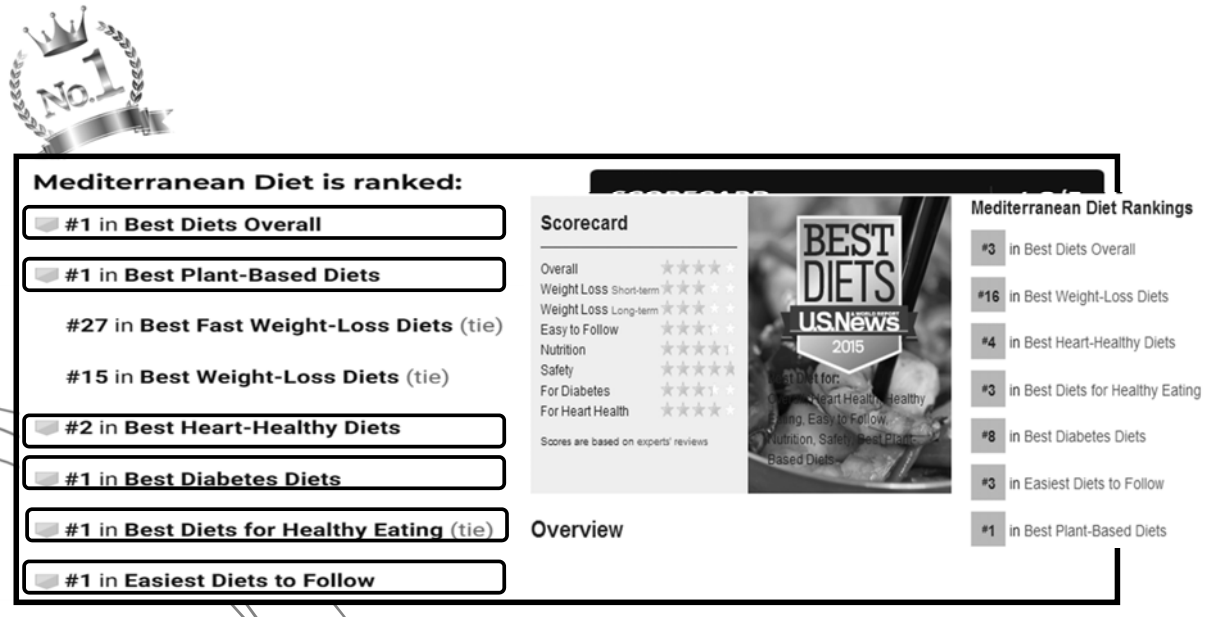
- 'the caveman diet' – is based on the principle that eating foods that were available to early humans will promote optimal health and prevent various disease conditions.
- One of the fundamental theories behind this diet is that modern food systems, production and processing techniques are damaging to human health
- This diet is an eating plan that emphasizes natural environmental foods and eliminates grains, legumes and most processed foods.
- With a theoretical belief that each species is genetically adapted to thrive on the diet eaten by its ancestors (low carbohydrate and high fat).
- Modified Paleo diet: 80/20 Palaeolithic diet、Palaeolithic ketogenic diet 、Pegan diet……

沒有放諸四海皆準的標準飲食

Efficacy vs. Effectiveness

Which diet is the best?

Which is the easiest to follow?



http://health.usnews.com/best-diet/

Flexitarian diet

- flexible and vegetarian
- Dawn Jackson Blatner (2009): "The Flexitarian Diet: The Mostly Vegetarian Way to Lose Weight, Be Healthier, Prevent Disease and Add Years to Your Life,"
- You can be a vegetarian most of the time, but still chow down on a burger or steak when the urge hits.
- By eating more plants and less meat, it's suggested that adherents to the diet will not only lose weight but can improve their overall health, lowering their rate of heart disease, diabetes and cancer, and live longer as a result.
- Adding five food groups to your diet – not taking any away. These are: the "new meat" (non-meat proteins like beans, peas or eggs); fruits and veggies; whole grains; dairy; and sugar and spice

WW (Weight Watchers) Diet is ranked:

- **#4** in **Best Diets Overall**
- **#3** in **Best Fast Weight-Loss Diets** (tie)
- **#1** in **Best Weight-Loss Diets**
- **#13** in **Best Heart-Healthy Diets** (tie)
- **#9** in **Best Diabetes Diets** (tie)
- **#1** in **Best Commercial Diet Plans**
- **#6** in **Best Diets for Healthy Eating** (tie)
- **#3** in **Easiest Diets to Follow** (tie)

SCORECARD	3.9/5
Short-Term Weight Loss	3.8/5
Long-Term Weight Loss	3.4/5
Easy to Follow	3.4/5
Healthy	4.5/5

Scores are based on experts' reviews.

MIND Diet is ranked:

- **#5** in **Best Diets Overall** (tie)
- **#32** in **Best Fast Weight-Loss Diets**
- **#27** in **Best Weight-Loss Diets**
- **#7** in **Best Heart-Healthy Diets** (tie)
- **#11** in **Best Diabetes Diets** (tie)
- **#4** in **Best Diets for Healthy Eating** (tie)
- **#3** in **Easiest Diets to Follow** (tie)

SCORECARD	3.8/5
Short-Term Weight Loss	2.7/5
Long-Term Weight Loss	2.7/5
Easy to Follow	3.4/5
Healthy	4.6/5

Scores are based on experts' reviews.

TLC Diet is ranked:

- **#8** in **Best Diets Overall**
- **#23** in **Best Fast Weight-Loss Diets** (tie)
- **#24** in **Best Weight-Loss Diets** (tie)
- **#5** in **Best Heart-Healthy Diets**
- **#14** in **Best Diabetes Diets** (tie)
- **#4** in **Best Diets for Healthy Eating** (tie)
- **#10** in **Easiest Diets to Follow** (tie)

SCORECARD	3.7/5
Short-Term Weight Loss	3.0/5
Long-Term Weight Loss	2.7/5
Easy to Follow	2.7/5
Healthy	4.6/5

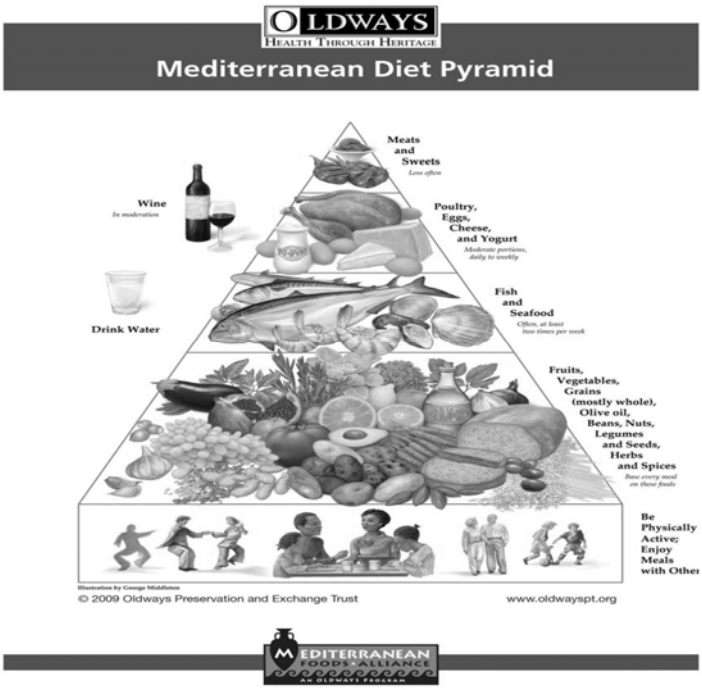
Scores are based on experts' reviews.

Vegetarian Diet is ranked:

- **#9** in **Best Diets Overall** (tie)
- **#3** in **Best Plant-Based Diets** (tie)
- **#18** in **Best Fast Weight-Loss Diets** (tie)
- **#10** in **Best Weight-Loss Diets** (tie)
- **#7** in **Best Heart-Healthy Diets** (tie)
- **#11** in **Best Diabetes Diets** (tie)
- **#12** in **Best Diets for Healthy Eating** (tie)
- **#13** in **Easiest Diets to Follow** (tie)

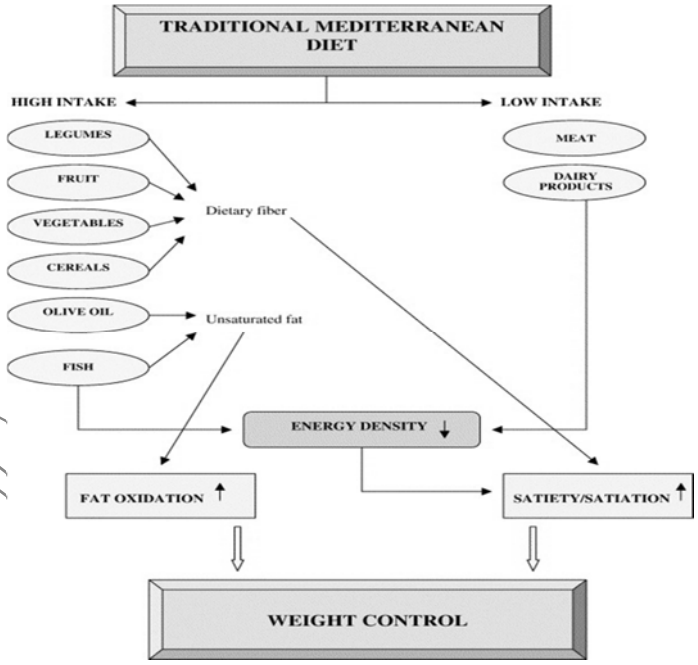
SCORECARD	3.6/5
Short-Term Weight Loss	3.2/5
Long-Term Weight Loss	3.0/5
Easy to Follow	2.6/5
Healthy	4.1/5

Scores are based on experts' reviews.



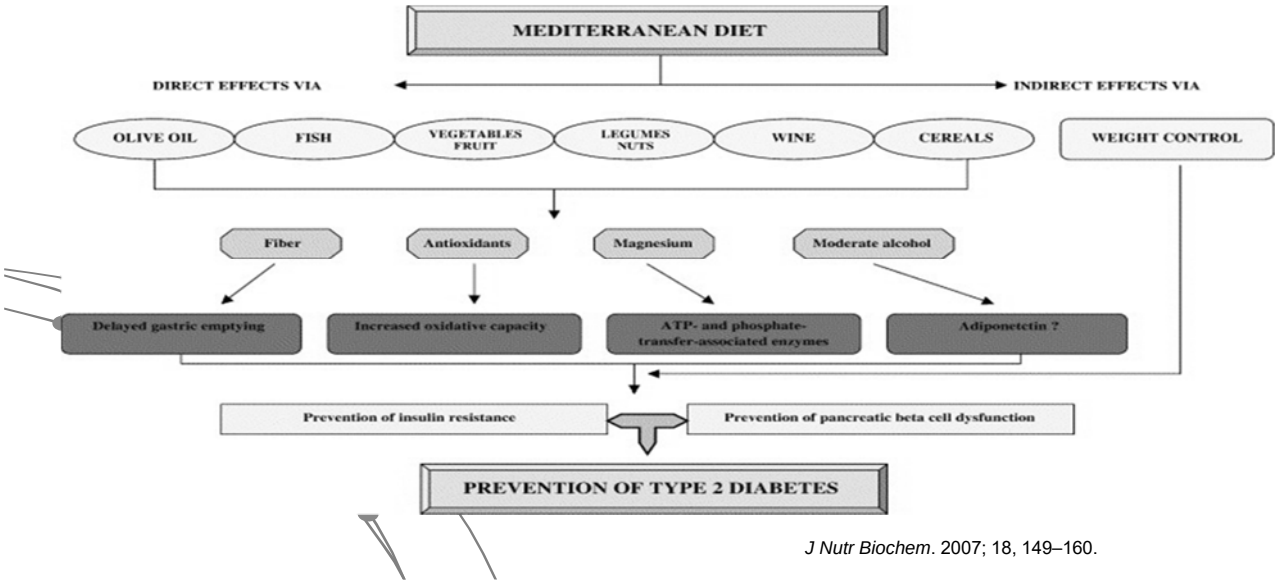
http://oldwayspt.org/resources/heritage-pyramids/mediterranean-pyramid/overview

Proposed mechanisms that link the Mediterranean diet with weight control



J Nutr Biochem. 2007; 18, 149–160.

Proposed mechanisms that link the Mediterranean diet with the prevention of type 2 diabetes



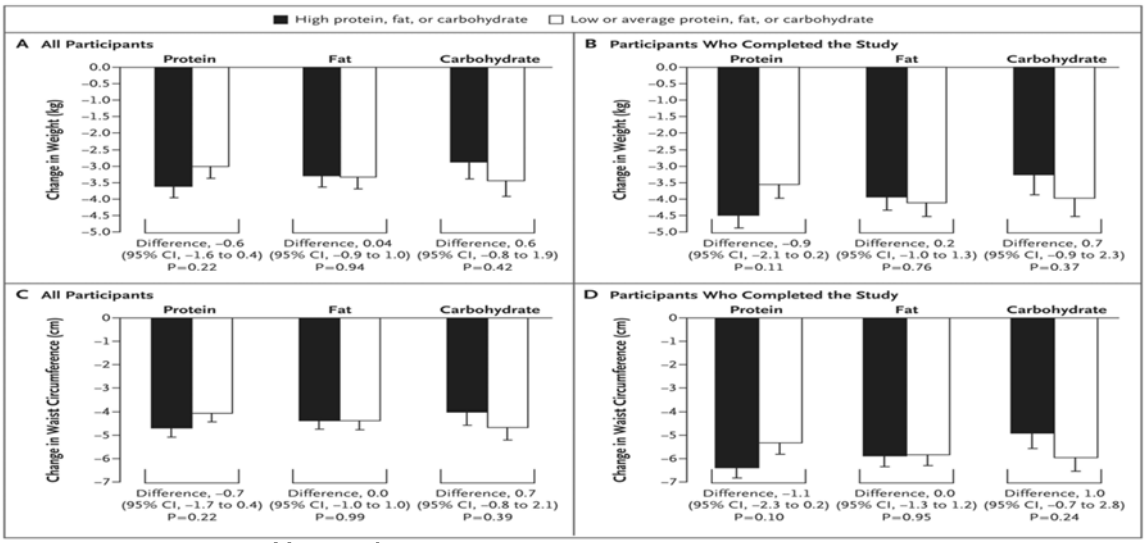
J Nutr Biochem. 2007; 18, 149–160.

Comparison of Weight-Loss Diets with Different Compositions of Fat, Protein, and Carbohydrates

- Randomly assigned 811 overweight adults to one of four diets; the targeted percentages of energy was
  - Fat / Prot / CHO = 20, 15, and 65%
  - Fat / Prot / CHO = 20, 25, and 55%
  - Fat / Prot / CHO = 40, 15, and 45%
  - Fat / Prot / CHO = 40, 25, and 35%
- The diets consisted of similar foods and met guidelines for cardiovascular health.
- The participants were offered group and individual instructional sessions for 2 years.
- The primary outcome： the change in body weight after 2 years in two-by-two factorial comparisons of low fat versus high fat and average protein versus high protein and in the comparison of highest and lowest carbohydrate content.

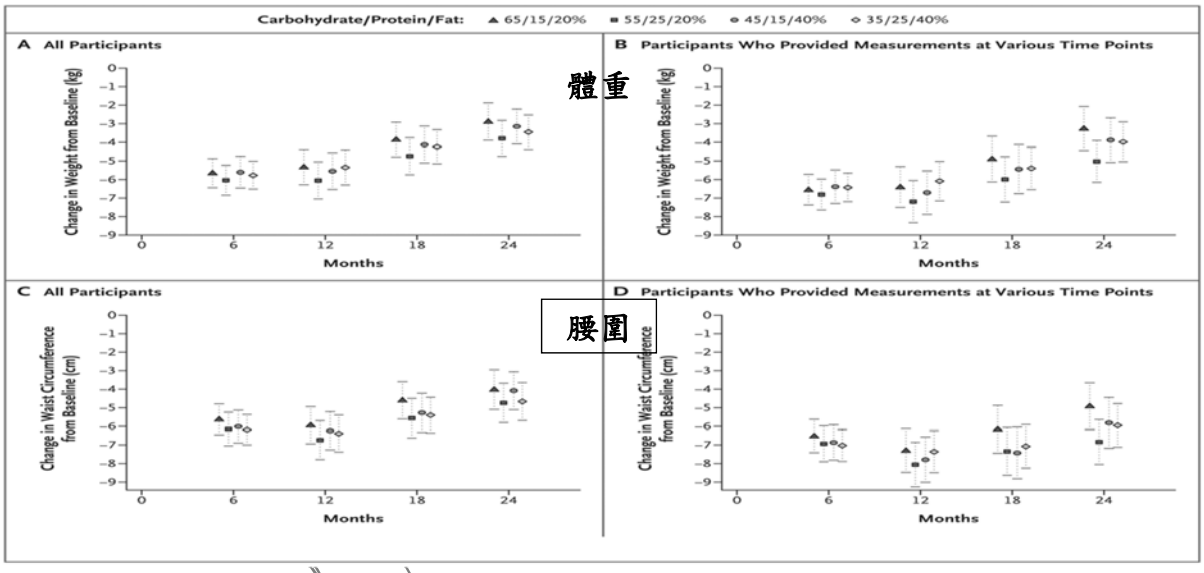
N Engl J Med. 2009; 360(9): 859–873

Mean Change in Body Weight and Waist Circumference
from Baseline to 2 Years

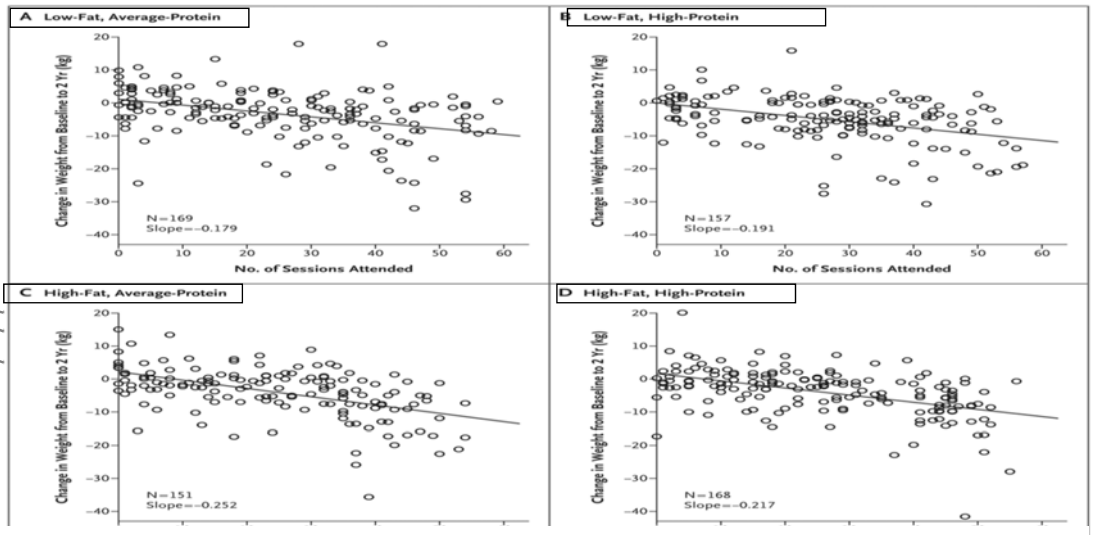


Reduced-calorie diets result in clinically meaningful weight loss regardless of which macronutrients they emphasize.

Mean Changes in Body Weight and Waist Circumference at Various Time Points



Change in Body Weight from Baseline to 2 Years According to Attendance at Counseling Sessions (645 Participants)



There were no significant differences among the regression coefficients

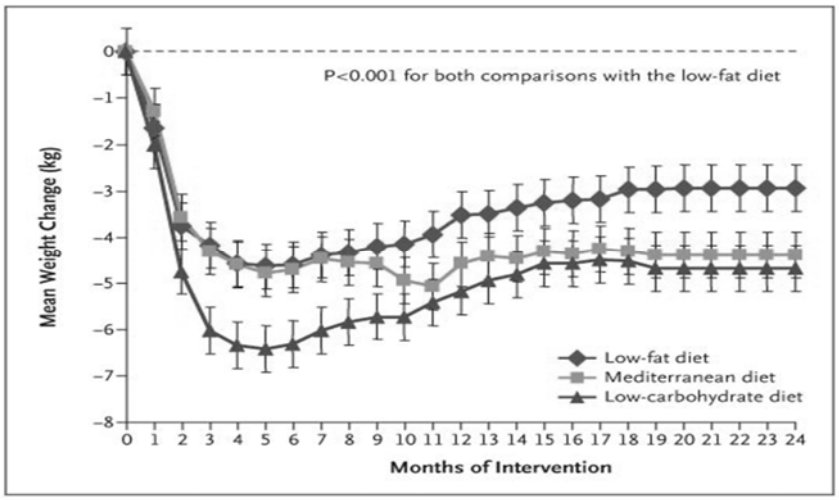
Attendance was strongly associated with weight loss (0.2 kg per session attended).

Weight loss with a low-carbohydrate, Mediterranean, or low-fat diet (DIRECT)

- subjects：322 type 2 or CVD, moderate obese (BMI= 31), mean age 51 years, randomly grouped
- Diet intervention
  - Low-fat diet: 1500 kcal/d for women, 1800 kcal/d for men, 30% fat (10% from SFA, 300 mg/d cholesterol)
  - Mediterranean diet: 1500 kcal/d for women, 1800 kcal/d for men, moderate-fat (≤35%)
  - Low-CHO diet: non-restricted-calorie diet, 20 g/d CHO for the 2-m induction period, with a gradual increase to a max of 120g/d, total cal, protein and fat were not limited. (chose plant fat and protein and avoided trans fat)

N Engl J Med 2008;359:229-241.

Weight Changes during 2 Years

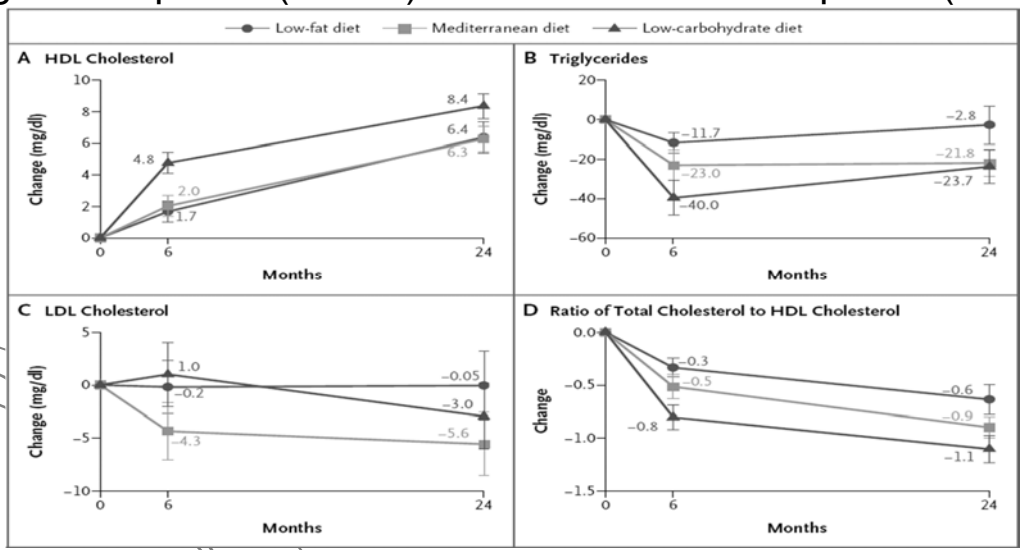


Mean wt loss: 2.9kg for low-fat, 4.4kg for M diet, 4.7kg for low-carb

For completer (n=272): 3.3, 4.6, 5.5 kg separately

N Engl J Med 2008;359:229-241. 29

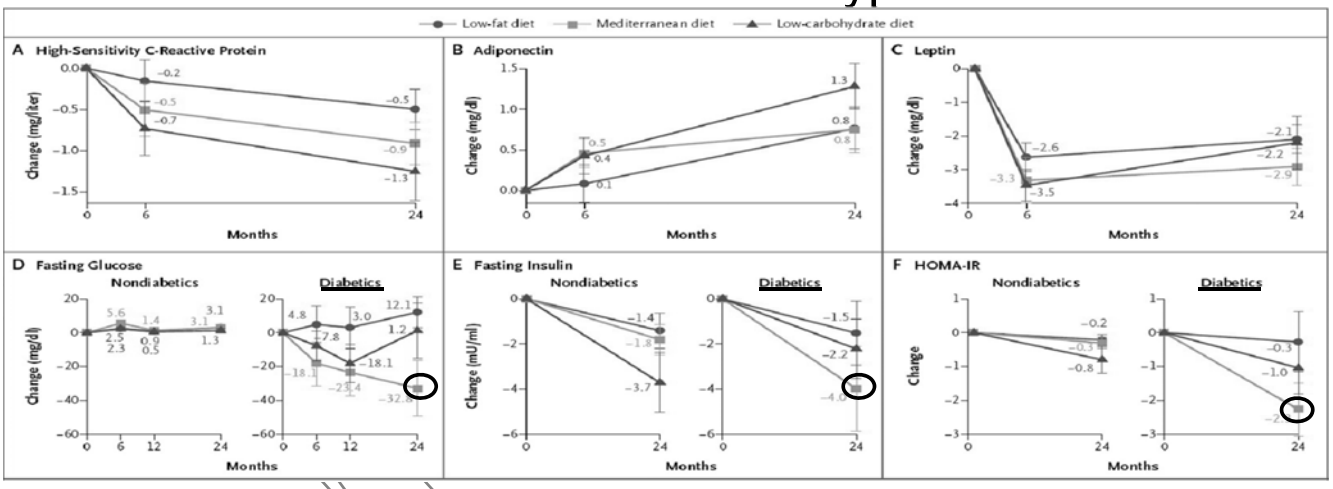
Changes in cholesterol and triglyceride during the maximum weight- loss phase (1- 6 m) and the maintenance phase (7 - 24 m)



Low CHO diet vs. Med diet 對血脂肪的影響各有千秋

N Engl J Med 2008;359:229-241. 30

Changes in Biomarkers According to Diet Group and Presence or Absence of Type 2 Diabetes



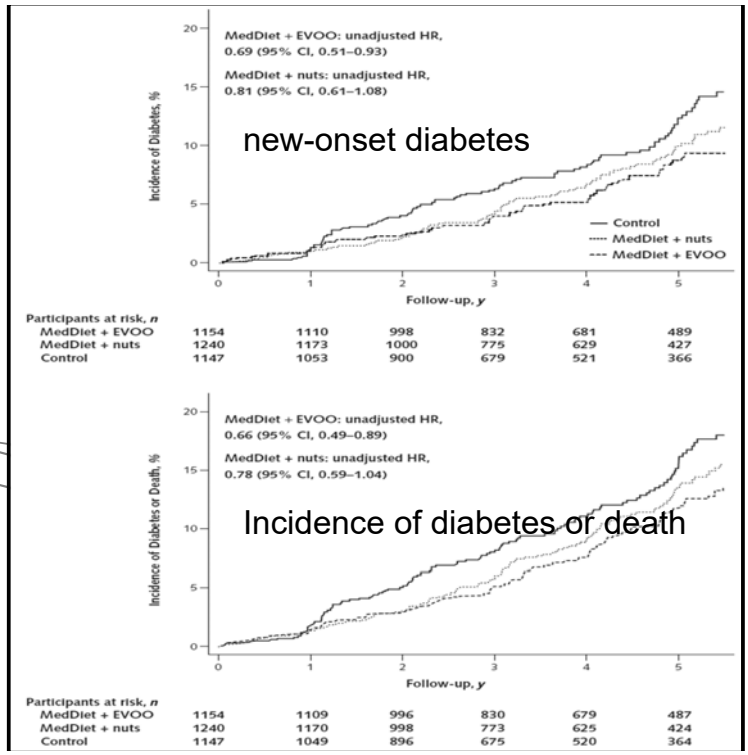
對肥胖的DM者而言，Med diet對glycemic control效果較好

N Engl J Med 2008;359:229-241.

Prevention of diabetes with Mediterranean diets-PREDIMED study

- A multicenter, randomized trial
- **Participants:** Men and women without diabetes (3541 patients aged 55 to 80 years) at high CV risk.
- **Intervention:** Participants were randomly assigned and stratified by site, sex, and age but not diabetes status to receive 1 of 3 diets: (No intervention to increase physical activity or lose weight was included.) no calorie restriction
  - Mediterranean diet supplemented with extra-virgin olive oil (EVOO)
  - Mediterranean diet supplemented with nuts
  - Control diet (advice on a low-fat diet)
- **Measurements:** Incidence of new-onset type 2 DM

Ann Inter Med. 2014; 160, 1-10.



Control: 101/1147=8.81%

MedDiet + nuts: 92/1240= 7.42%

MedDiet + EVOO: 80/1154=6.93%

Ann Inter Med. 2014; 160, 1-10.

Table 3. **HRs of Diabetes***

Model	HR (95% CI)		
	MedDiet + EVOO vs. Control Diet	MedDiet + Nuts vs. Control Diet	Both MedDiets vs. Control Diet
Crude	0.69 (0.51–0.92)	0.81 (0.61–1.08)	0.75 (0.58–0.96)
Age- and sex-adjusted	0.68 (0.51–0.92)	0.80 (0.60–1.06)	0.74 (0.58–0.95)
Multivariate-adjusted A†	0.68 (0.51–0.92)	0.82 (0.61–1.09)	0.75 (0.58–0.96)
Multivariate-adjusted B‡	0.60 (0.43–0.85)	0.82 (0.61–1.10)	0.70 (0.54–0.92)

EVOO = extra-virgin olive oil; HR = hazard ratio; MedDiet = Mediterranean diet.
* Cox regression models were used to assess the relative risk of diabetes by allocation group, estimating the HRs and 95% CIs.
† Adjusted for age, sex, and body mass index.
‡ Additionally adjusted for baseline smoking status (never, current, or former smoker), fasting glucose level, prevalence of dyslipidemia (yes/no) and hypertension (yes/no), total energy intake level (kcal/d), adherence to MedDiet (14-point score), physical activity level (metabolic equivalent of min/d), education level (primary education, secondary education, and academic/graduate), and alcohol intake level (continuous in g/d, adding a quadratic term). All models were stratified by recruitment center, and robust SEs were used.

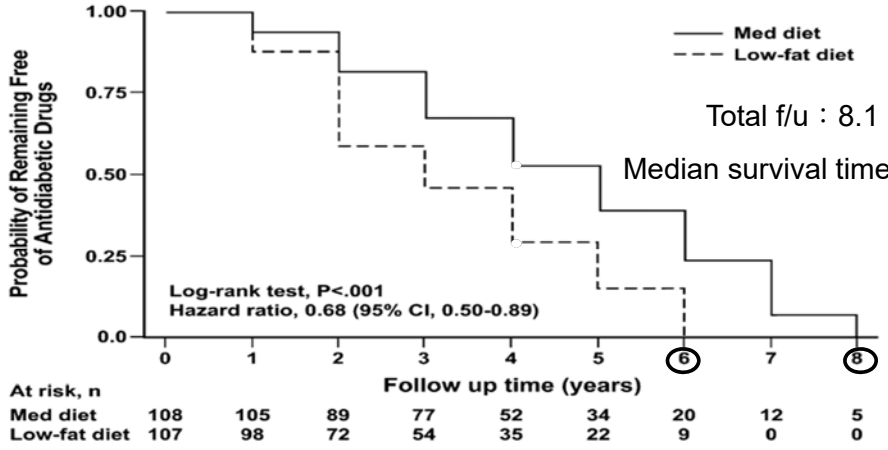
When both Mediterranean diet groups were merged, a 30% relative risk reduction versus control was apparent (HR, 0.70 [CI, 0.54 to 0.92]).

The effects of Mediterranean diet on the need for diabetes drugs

- Overweight, middle-aged, newly diagnosed type 2 DM
- Randomized to
  - Low CHO Mediterranean diet (LCMD)
  - Low fat diet
- After 4 years, subjects were still free of medications were further follow up
  - Primary end point ：need of a diabetic drug or HbA1c＞7%
  - Remission of diabetes (partial or complete)
  - Change in weight, glycemic control, CV risk factors

Diabetes Care. 2014; 37, 1824-1830.

Probability of remaining free of antihyperglycemic drug therapy



Total f/u：8.1 y vs. 6.1 y

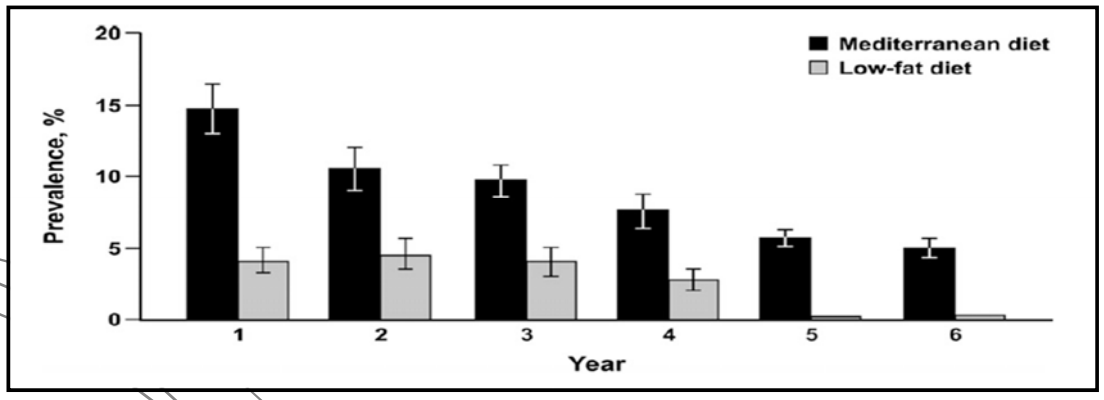
Median survival time：4.8 y vs. 2.8 y

Figure 1—Probability of remaining free of antihyperglycemic drug therapy. Cumulative HR for the primary end point (need for diabetes medications).

After the end of the core intervention(4 years), the cumulative incidence of achieving primary end point was 44% in the LCMD group vs. 70% in the low fat group (P＜0.001): the corresponding unadjusted hazard ratio (HR) was 0.68

Diabetes Care. 2014; 37, 1824-1830.

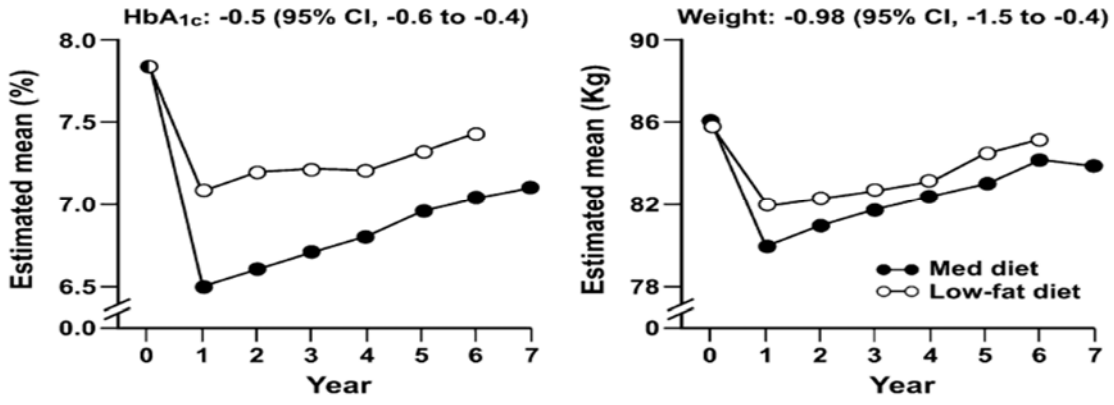
Prevalence of any remission (partial or complete) by intervention and year



MD：14.7%	9.7%	5%
LF：4.1%	4.0%	0%

Diabetes Care. 2014; 37, 1824-1830.

Changes in HbA1c and weight during the years of follow-up

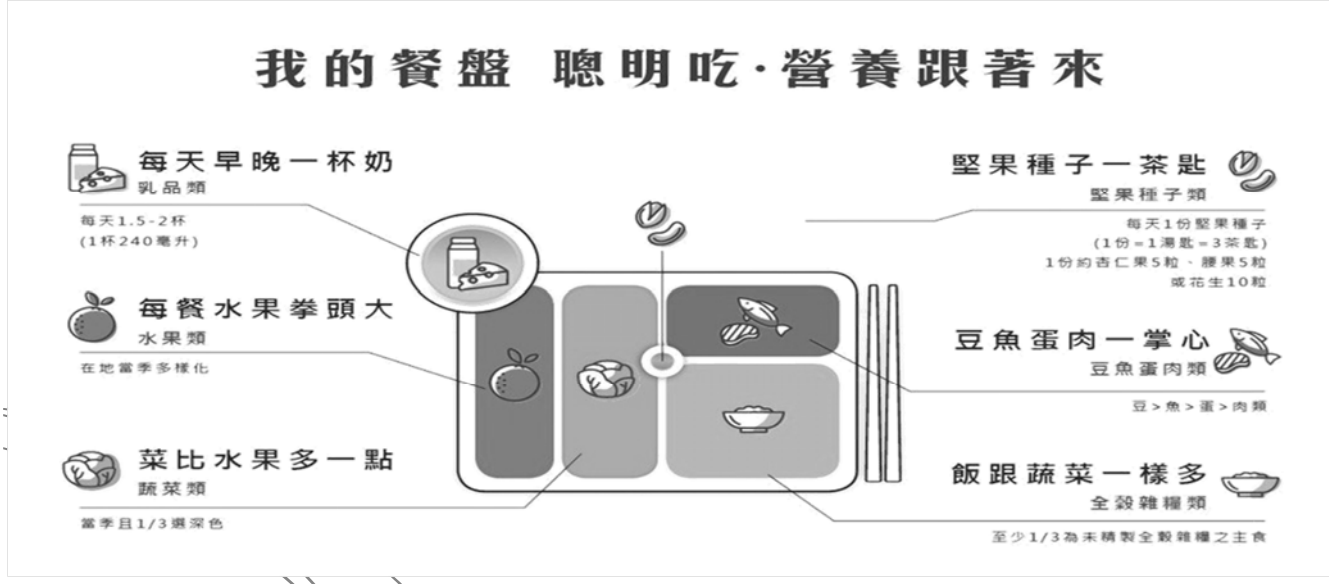


Diabetes Care. 2014; 37, 1824-1830.

衛福部國民營養健康狀況變遷調查

	年齡	熱量(kcal)	蛋白質(%)	脂質(%)	醣類(%)
男性	19-30	2320	16.8	34.5	48.7
	31-64	2377	17.3	33.4	49.4
	≥65	1711	16.9	29.1	54.0
女性	19-30	1878	16.2	34.1	49.7
	31-64	1672	17.0	31.3	51.6
	≥65	1316	16.7	27.8	55.5

吳幸娟等台灣成人與老人營養素及食物攝取來源之變遷趨勢：由NASHIT 1993~1996到2005~2008。衛福部食藥署
https://consumer.fda.gov.tw/Pages/List.aspx?nodeID=287



個人意見:

1.我的餐盤在社區好應用，民眾易懂，但是對糖尿病人而言需要調整。

2.調整：計量容器的大小，每餐飯和水果一樣多，衛教學會的餐盤也可以應用。

Effects of carbohydrate eaten at dinner

- 63 police officers with BMI ＞30
- Low calorie diet (1300-1500 kcal/day, 20% protein, 30-35% fat, 45-50% CHO) for 6 m
  - Experiment group ：eat CHO mostly at dinner
  - Control group ：eat CHO throughout the day
- Meet dietitian at 1-3 week intervals and each of the study time points
- Measurement
  - Hunger-Satiety Scale questionnaire (H-SS)
  - Anthropometric parameters
  - Biochemical and inflammatory parameters
  - Leptin, ghrelin, adiponectin profiles

Obesity. 2011; 19, 2006-2014.

Changes in anthropometric parameters

Table 3 Changes in anthropometric parameters after 6 months on diet

	Units	Experimental group (n = 30)	Control group (n = 33)	Comparison of groups
Weight loss				
	(kg)	11.6 ± 0.84*	9.06 ± 0.84*	P = 0.024
	(%)	11.7 ± 0.66*	9.96 ± 0.79*	P = 0.053
BMI reduction				
Original	(g/m^2)	3.99 ± 0.24*	3.16 ± 0.27*	
Adjusted for baseline differences	(g/m^2)	3.85 ± 0.25*	3.28 ± 0.24*	P = 0.115
	(%)	11.7 ± 0.66*	9.68 ± 0.79*	P = 0.053
Abdominal circumference decrease				
Original	(cm)	11.7 ± 0.89*	9.39 ± 0.98*	
Adjusted for baseline differences	(cm)	11.1 ± 0.92*	10.0 ± 0.88*	P = 0.408
	(%)	10.5 ± 0.70*	8.80 ± 0.90*	P = 0.159
Body fat percent reduction				
Absolute	(%)	6.98 ± 0.95*	5.13 ± 0.59*	P = 0.710
Relative	(%)	18.1 ± 2.45*	14.1 ± 1.71*	P = 0.122

Mean ± s.e. Analysis by two-factor ANOVA.
*Significant difference from day 0 (P < 0.0001).

Obesity. 2011; 19, 2006-2014.

Biochemical and inflammatory parameters and percent of baseline

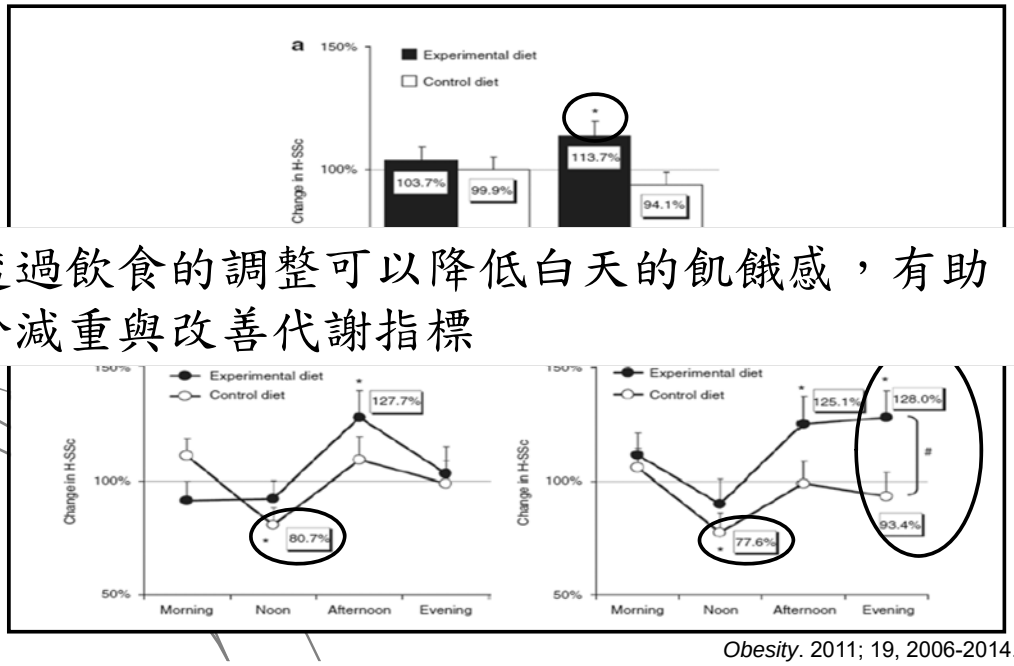
	Day	Experimental group (n = 18) Absolute mean	Experimental group (n = 18) % of baseline[a]	Control group (n = 21) Absolute mean	Control group (n = 21) % of baseline[a]	Comparison of groups
Insulin (μU/ml)	0	29.8 ± 5.52		23.2 ± 4.48		
	90	16.1 ± 1.93	84.4 ± 13.7	20.0 ± 3.61	102.9 ± 13.1	$P = 0.332$
	180	14.9 ± 2.79	68.0 ± 14.3*	16.6 ± 1.63	122.6 ± 12.8	$P = 0.006$
Glucose (mmol/l)	0	5.10 ± 0.26		4.85 ± 0.25		
	90	4.81 ± 0.15	88.6 ± 8.35	4.77 ± 0.08	96.7 ± 6.84	$P = 0.454$
	180	4.71 ± 0.18	80.0 ± 7.53**	4.71 ± 0.16	93.7 ± 6.84	$P = 0.184$
$HOMA_{IR}$	0	1.68 ± 0.24		1.33 ± 0.20		
	90	1.14 ± 0.15	69.1 ± 15.8	1.33 ± 0.16	119.7 ± 12.8	$P = 0.015$
	180	1.09 ± 0.12	89.0 ± 15.2	1.20 ± 0.15	121.3 ± 13.2	$P = 0.114$
Triglycerides (mmol/l)	0	1.88 ± 0.17		2.00 ± 0.17		
	90	1.22 ± 0.09	69.2 ± 7.20***	1.22 ± 0.14	65.8 ± 5.92***	$P = 0.717$
	180	1.20 ± 0.13	70.6 ± 6.95***	1.33 ± 0.17	68.7 ± 6.00***	$P = 0.834$
Total cholesterol (mmol/l)	0	5.46 ± 0.18		5.02 ± 0.15		
	90	4.94 ± 0.17	91.9 ± 2.63**	4.76 ± 0.18	95.7 ± 2.45	$P = 0.290$
	180	5.32 ± 0.23	97.6 ± 2.75	4.87 ± 0.18	96.3 ± 2.48	$P = 0.733$
LDL-cholesterol (mmol/l)	0	3.66 ± 0.18		3.14 ± 0.15		
	90	3.29 ± 0.18	89.0 ± 3.52**	3.18 ± 0.15	97.8 ± 3.28	$P = 0.073$
	180	3.43 ± 0.22	90.3 ± 3.70*	3.00 ± 0.13	92.4 ± 3.26*	$P = 0.670$
HDL-cholesterol (mmol/l)	0	0.78 ± 0.06		0.83 ± 0.05		
	90	0.88 ± 0.04	114.3 ± 4.48**	0.91 ± 0.04	110.4 ± 4.18*	$P = 0.525$
	180	1.07 ± 0.09	140.8 ± 4.65***	1.05 ± 0.05	126.0 ± 4.16**	$P = 0.022$
CRP (mg/l)	0	8.2 ± 2.0		3.4 ± 0.6		
	90	5.6 ± 1.6	99.0 ± 19.8[b]	2.5 ± 0.4	98.3 ± 19.1[b]	$P = 0.979$
	180	3.9 ± 1.1	72.2 ± 20.8[b]	2.2 ± 0.4	94.2 ± 19.5[b]	$P = 0.456$
TNF-α (pg/ml)	0	1.89 ± 0.15		1.93 ± 0.24		
	90	1.85 ± 0.18	101.4 ± 8.39	2.14 ± 0.29	117.3 ± 7.80*	$P = 0.169$
	180	1.65 ± 0.16	90.8 ± 8.82	2.12 ± 0.33	116.2 ± 7.78*	$P = 0.034$
IL-6 (pg/ml)	0	2.71 ± 0.33		2.52 ± 0.26		
	90	2.22 ± 0.33	84.8 ± 13.4	2.06 ± 0.27	91.5 ± 11.9	$P = 0.710$
	180	1.61 ± 0.21	63.0 ± 13.4**	1.84 ± 0.20	76.3 ± 12.2	$P = 0.465$

1、二組皆改善：TG、LDL、HDL

2、僅實驗組改善：insulin、glucose、TC、IL-6

3、二組間有差異：insulin、$HOMA_{IR}$、HDL、TNF-α

Changes in hunger and satiety scales (H-SS)



透過飲食的調整可以降低白天的飢餓感，有助於減重與改善代謝指標

Obesity. 2011; 19, 2006-2014.

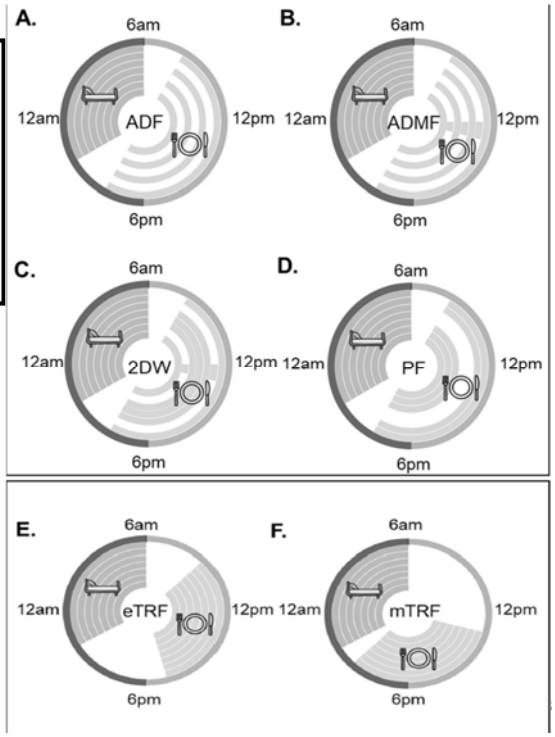
Table 1 Experimental/control diets

Experimental diet	
Breakfast	Coffee/tea + artificial sweetener + 1/5 cup of low fat milk + 7 walnut halves/7 almonds
Morning snack (1000 hours)	Plain low fat yogurt/white cheese (1/2 cup) + vegetable
Lunch	Meat/fish dish (without coating, excluding ground meat) + boiled vegetables/vegetable soup + vegetable salad + 1 teaspoon of oil/tablespoon of dressing (from the permitted list)
Afternoon snack (1600 hours)	Coffee/tea + artificial sweetener + 1/5 cup of low fat milk + 7 walnut halves/7 almonds
Dinner	Coffee/tea + artificial sweetener + 1/5 cup of low fat milk + alternative A or B
	Alternative A:
	2–4 pieces of bread/4–8 pieces of reduced calorie bread + 1/2 cup of white cheese/1 slice of yellow cheese/ 2 tablespoons of humus/egg/1/2 a can of tuna fish/4 slices of pastrami + vegetable salad + 1 teaspoon of oil/ tablespoon of tehina/1/4 avocado/1 tablespoon of dressing + fruit/fruit yogurt/diet ice-cream/2 biscuits/1 cookie
	Alternative B:
	1–2 cups of cooked rice/pasta/puree/corn/legumes/1–2 potato/1–2 sweet potato + 1 tablespoon of gravy + boiled vegetables/vegetables salad + 1 teaspoon of oil/ tablespoon of tehina/1/4 avocado/1 tablespoon of dressing + fruit yogurt/diet ice-cream/2 biscuits/1 cookie
Night snack (upon need)	Coffee/tea + artificial sweetener + 1/5 cup of low fat milk + 7 walnut halves/7 almonds + plain yogurt/white cheese (1/2 cup)
Beverages	Water/no-calorie diet drinks
Control diet	
Breakfast	Coffee/tea + artificial sweetener + low fat milk +1 piece of bread/2 pieces of reduced calorie bread/2 crackers/ 2 biscuits + white cheese
Morning snack (1000 hours)	Plain yogurt/fruit yogurt + 7 walnut halves/7 almonds
Lunch	Meat/fish dish + boiled vegetables/vegetable soup + vegetable salad + 1 teaspoon of oil/tablespoon of dressing + 1/2 cup of cooked rice/pasta/ puree/corn/legumes/1/2 potato/1/2 sweet potato
Afternoon snack (1600 hours)	Coffee/tea + artificial sweetener + low fat milk + 2 biscuits/fruit + 7 walnut halves/7 almonds
Dinner	Coffee/tea + artificial sweetener + low fat milk + 1-2 piece of bread/2–4 pieces of light bread/2–4 crackers + 1/2 cup of white cheese /1 slice of yellow cheese/2 tablespoons of humus/egg/1/2 a can of tuna fish/4 slices of sliced turkey breast + vegetable salad + 1 teaspoon of oil/tablespoon of tehina/1/4 avocado/tablespoon of dressing
Night snack (If needed)	Coffee/tea + artificial sweetener + low fat milk + 7 walnut halves/7 almonds + plain yogurt/fruit yogurt/diet ice-cream
Beverages	Water/no-calorie diet drinks

Intermittent fasting (IMF): recurring periods (e.g., 16–48 h) with little or no energy intake.
(A) alternate day fasting (zero calorie intake on fast days),
(B) alternate day modified fasting (>60% energy restriction on fast days)
(C)fasting or modified fasting on two days per week (2DW)
(D) Periodic fasting involves fasting for 2 to as many as 21 or more days.

- Green shaded areas represent eating periods.
- Grey shaded areas indicate the sleeping time.
- white circles/spaces indicate fasting periods.

Time-restricted feeding (TRF): eating patterns that are restricted to a short (<8–10 h) interval each day, such as during the
(E) Early TRF
(F) mid-day TRF



Nutrients 2019, 11, 1-23.

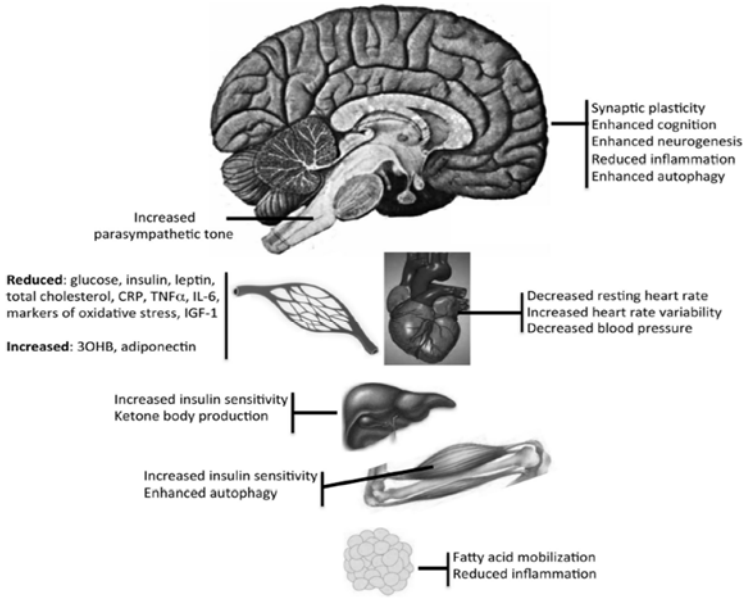
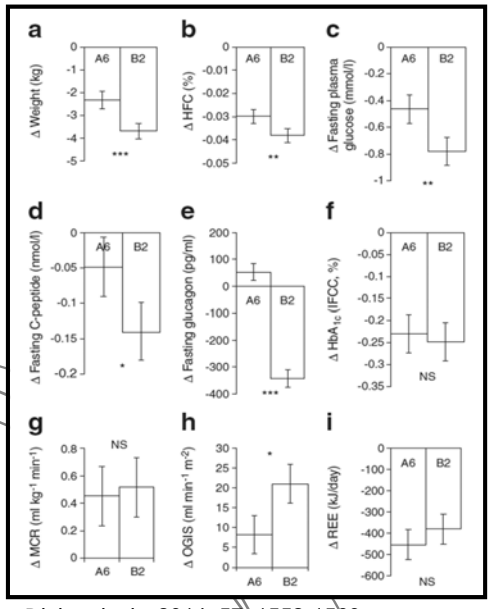


Fig. 3. Examples of effects of intermittent fasting on different organ systems.
Abbreviations:: 3OHB, 3-hydroxybutyrate; CRP, C-reactive protein; IGF-1, insulin-like growth factor 1; IL-6, interleukin 6; TNFα, tumor necrosis factor α.

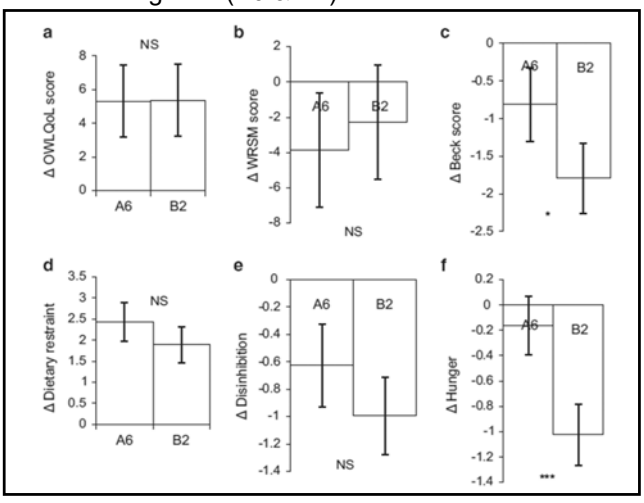
in experimental models, IMF could improve functional outcome of a wide range of age-related disorders including diabetes, cardiovascular disease, cancers and neurological disorders such as Alzheimer's disease Parkinson's disease and stroke.

Ageing Research Reviews 39 (2017) 46–58

Do patients with type 2 diabetes still need to eat snacks?



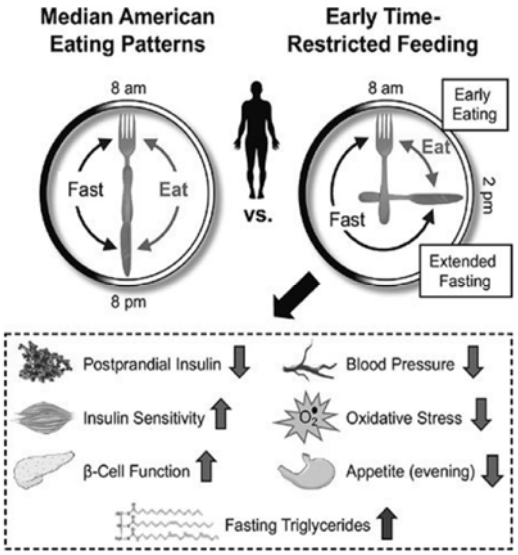
- RCT, crossover, 54 type 2 DM
- Cal need: (REE*1.5)-500
- Each regimen (A6 & B2) 12 weeks



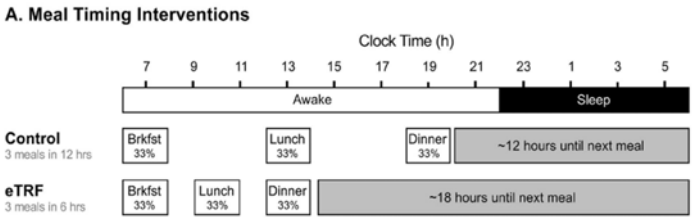
Diabetologia, 2014, 57, 1552-1560

European Journal of Clinical Nutrition, 2015, 69, 755–756

Early Time-Restricted Feeding Improves Insulin Sensitivity, Blood Pressure, and Oxidative Stress Even Without Weight Loss in Men with Prediabetes

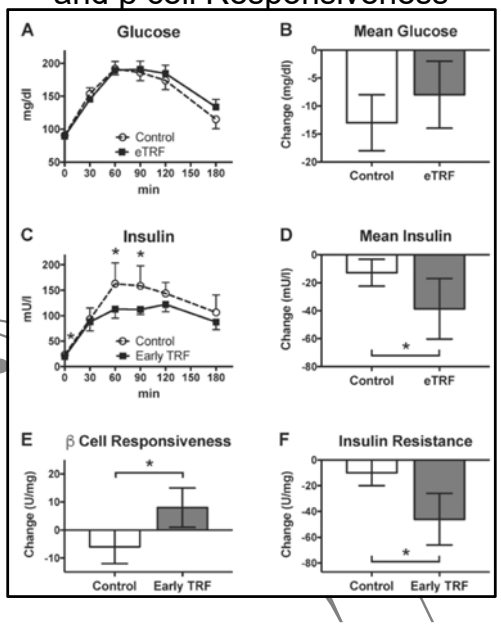


- a 5-week, randomized, crossover, isocaloric controlled feeding trial
- men with prediabetes
- eTRF schedule (6-hour daily eating period, with dinner before 15:00 h) and a control schedule (12-hour eating period) for five weeks each
- washout period: 7 weeks.

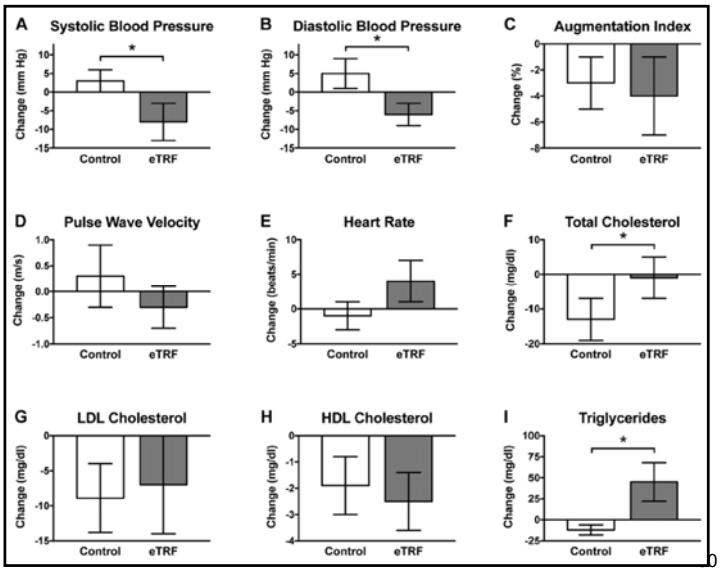


Cell Metab, 2018, 27(6): 1212–1221

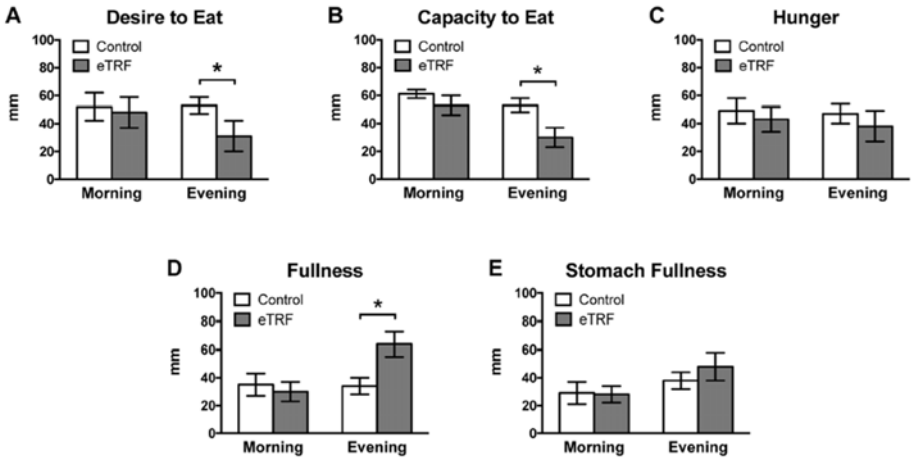
eTRF Reduces Insulin Levels and Improves Insulin Sensitivity and β cell Responsiveness



eTRF Lowers Blood Pressure but Does Not Affect Arterial Stiffness, LDL Cholesterol, or HDL Cholesterol

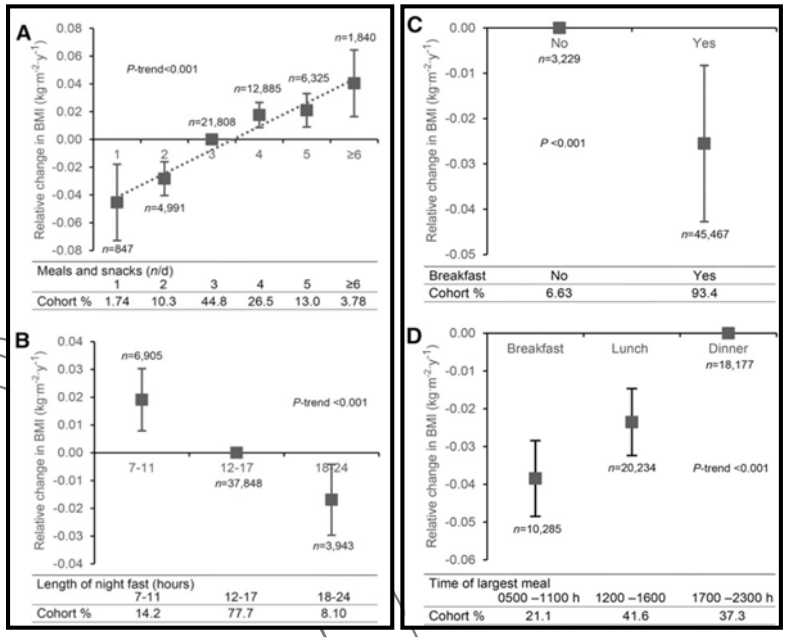


eTRF Reduces Appetite in the Evening



- Early time-restricted feeding (eTRF) increases insulin sensitivity
- eTRF also improves β cell function and lowers blood pressure
- eTRF lowers the desire to eat in the evening, which may facilitate weight loss
- Intermittent fasting can improve health even in the absence of weight loss

Meal Frequency and Timing Are Associated with Changes in Body Mass Index in Adventist Health Study 2



The analysis used data from 50,660 adult members aged ≧30 y of Seventh-day Adventist churches in the US and Canada (mean ± SD follow-up: 7.42 ± 1.23 y).

1.eating less frequently, no snacking

2.consuming breakfast

3.eating the largest meal in the morning may be effective methods for preventing long-term weight gain.

4.eating breakfast and lunch 5–6 h apart and making the overnight fast last 18–19 h may be a useful practical strategy.

J Nutr 2017;147:1722–8.

Associations of Meal Timing and Frequency with Obesity and Metabolic Syndrome among Korean Adults

Data from the 2013–2017 Korea National Health and Nutrition Examination Survey (KNHANES)

- 14279位(5854男性，8425女性)
- A single day 24-h dietary recall
- Morning eating：05:00-09:00
- Evening eating: 18:00-21:00
- Night eating：after 21:00

Nutrients, 2019, 11, 2437

Men (n = 5854)	Obesity	Metabolic Syndrome	Abdominal Obesity	Elevated Blood Pressure	Reduced HDL-Cholesterol	Elevated Triglycerides	Elevated Fasting Glucose
Eating episodes (times/day)							
Q1 (median 4) (n = 1968)	1.00 [1,2]	1.00	1.00	1.00	1.00	1.00	1.00
Q2 (median 5) (n = 1213)	1.02 (0.86–1.20)	0.93 (0.74–1.18)	0.95 (0.79–1.15)	0.95 (0.79–1.14)	0.90 (0.72–1.11)	0.93 (0.77–1.12)	1.10 (0.91–1.32)
Q3 (median 6) (n = 1062)	0.85 (0.70–1.04)	0.80 (0.62–1.03)	0.86 (0.69–1.06)	0.85 (0.70–1.02)	0.92 (0.73–1.16)	0.79 (0.65–0.96)	0.88 (0.71–1.08)
Q4 (median 8) (n = 1611)	0.95 (0.81–1.12)	0.84 (0.67–1.05)	0.82 (0.69–0.98)	0.82 (0.68–0.99)	0.93 (0.76–1.14)	0.81 (0.68–0.96)	1.08 (0.90–1.30)
Nightly fasting duration (hours/day)							
<8 (n = 300)	0.83 (0.59–1.17)	0.97 (0.60–1.59)	0.78 (0.54–1.13)	0.82 (0.55–1.21)	0.84 (0.54–1.29)	0.71 (0.50–1.02)	1.17 (0.77–1.78)
8–10 (n = 897)	0.82 (0.62–1.09)	1.02 (0.69–1.50)	0.74 (0.54–1.01)	0.90 (0.66–1.24)	0.99 (0.69–1.41)	0.80 (0.60–1.08)	1.32 (0.95–1.85)
10–12 (n = 1756)	0.75 (0.57–0.98)	0.83 (0.58–1.19)	0.70 (0.53–0.92)	0.83 (0.63–1.10)	0.84 (0.60–1.18)	0.69 (0.53–0.91)	1.25 (0.91–1.71)
12–16 (n = 2463)	0.85 (0.66–1.09)	0.91 (0.63–1.30)	0.81 (0.62–1.06)	0.94 (0.72–1.23)	0.89 (0.65–1.23)	0.83 (0.64–1.08)	1.22 (0.89–1.68)
≥16 (n = 438)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Morning eating							
No (n = 2176)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes (n = 3678)	0.95 (0.83–1.09)	0.83 (0.70–0.99)	0.87 (0.75–1.00)	1.00 (0.86–1.16)	0.87 (0.73–1.03)	0.76 (0.66–0.87)	0.99 (0.86–1.15)
Night eating							
No (n = 2933)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes (n = 2921)	0.89 (0.78–1.01)	1.25 (1.04–1.49)	0.89 (0.78–1.02)	0.95 (0.83–1.10)	1.18 (1.01–1.38)	1.06 (0.92–1.22)	1.08 (0.94–1.25)

Women (n = 8425)	Obesity	Metabolic Syndrome	Abdominal Obesity	Elevated Blood Pressure	Reduced HDL-Cholesterol	Elevated Triglycerides	Elevated Fasting Glucose
Eating episodes (times/day)							
Q1 (median 4) (n = 2789)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q2 (median 5) (n = 2171)	0.86 (0.73–1.00)	1.04 (0.82–1.32)	0.92 (0.77–1.10)	0.93 (0.77–1.14)	0.96 (0.83–1.10)	0.88 (0.72–1.08)	1.09 (0.91–1.31)
Q3 (median 6) (n = 1756)	0.93 (0.78–1.12)	0.92 (0.71–1.20)	0.95 (0.77–1.16)	0.90 (0.73–1.12)	1.07 (0.91–1.24)	0.88 (0.71–1.08)	1.01 (0.83–1.23)
Q4 (median 7) (n = 1709)	0.90 (0.76–1.07)	0.95 (0.73–1.25)	0.88 (0.72–1.08)	1.01 (0.83–1.24)	1.09 (0.92–1.28)	0.90 (0.74–1.11)	1.03 (0.84–1.26)
Nightly fasting duration (hours/day)							
<8 (n = 180)	0.76 (0.48–1.21)	0.59 (0.29–1.19)	0.63 (0.36–1.09)	0.61 (0.34–1.11)	1.13 (0.75–1.71)	1.20 (0.72–1.99)	0.95 (0.57–1.61)
8–10 (n = 783)	0.87 (0.65–1.16)	0.71 (0.45–1.11)	0.80 (0.56–1.13)	1.02 (0.69–1.51)	0.90 (0.69–1.18)	0.82 (0.57–1.18)	1.00 (0.72–1.38)
10–12 (n = 2290)	0.79 (0.62–1.00)	0.76 (0.52–1.12)	0.74 (0.56–0.98)	0.92 (0.65–1.29)	0.96 (0.77–1.20)	0.93 (0.68–1.28)	0.96 (0.73–1.26)
12–16 (n = 4451)	0.92 (0.74–1.16)	0.91 (0.64–1.29)	0.90 (0.70–1.16)	0.98 (0.71–1.35)	1.08 (0.88–1.32)	0.95 (0.71–1.27)	0.96 (0.74–1.24)
≥16 (n = 721)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Morning eating							
No (n = 3574)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes (n = 4851)	0.91 (0.80–1.03)	0.71 (0.59–0.87)	0.82 (0.70–0.95)	0.94 (0.80–1.11)	0.90 (0.80–1.01)	0.89 (0.76–1.03)	0.80 (0.69–0.92)
Night eating							
No (n = 5073)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes (n = 3352)	0.91 (0.81–1.03)	1.00 (0.82–1.21)	0.96 (0.83–1.11)	0.95 (0.81–1.12)	1.02 (0.91–1.15)	1.05 (0.91–1.22)	1.07 (0.93–1.24)

Adjusted for age, BMI (except for obesity and abdominal obesity), education, household income, type of work, survey period, alcohol consumption, smoking, physical activity, and total energy intake.

Men (n = 5854)	Obesity	Metabolic Syndrome	Abdominal Obesity	Elevated Blood Pressure	Reduced HDL-Cholesterol	Elevated Triglycerides	Elevated Fasting Glucose
Eating episodes (times/day)							
Q1 (median 4) (n = 1968)	1.00 [1,2]	1.00	1.00	1.00	1.00	1.00	1.00
No (n = 2933)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes (n = 2921)	0.89 (0.78–1.01)	1.25 (1.04–1.49)	0.89 (0.78–1.02)	0.95 (0.83–1.10)	1.18 (1.01–1.38)	1.06 (0.92–1.22)	1.08 (0.94–1.25)

女性:

1.Meal frequency: 餐數和肥胖或代謝症候群無顯著相關

2.Night fasting duration: 每晚空腹10-12h者比≧16h者, 較少 abd obesity

3.Morning eating: 吃早餐者較少代謝症候群、abd obesity 及FG高

4.Night eating: 和各項指標都無明顯相關

Women (n = 8425)	Obesity	Metabolic Syndrome	Abdominal Obesity	Elevated Blood Pressure	Reduced HDL-Cholesterol	Elevated Triglycerides	Elevated Fasting Glucose
Eating episodes (times/day)							
Q1 (median 4) (n = 2789)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes (n = 3352)	0.91 (0.81–1.03)	1.00 (0.82–1.21)	0.96 (0.83–1.11)	0.95 (0.81–1.12)	1.02 (0.91–1.15)	1.05 (0.91–1.22)	1.07 (0.93–1.24)

男性:

1.Meal frequency:每天吃8餐者比平均4餐者有較少的central obesity, BP ↑, TG ↑

2.Night fasting duration: 每晚空腹10-12h者比≧16h者, 較少肥胖, abd obesity, high TG

3.Morning eating: 吃早餐者較少代謝症候群及TG高

4.Night eating: 明顯增加代謝症候群及降低HDL

Adjusted for age, BMI (except for obesity and abdominal obesity), education, household income, type of work, survey period, alcohol consumption, smoking, physical activity, and total energy intake.

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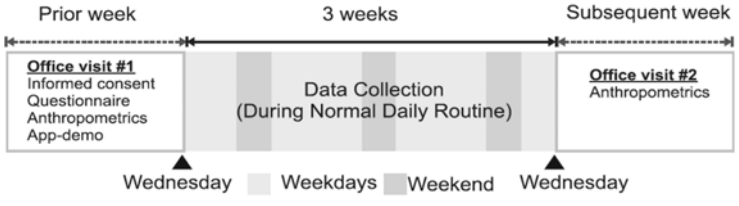
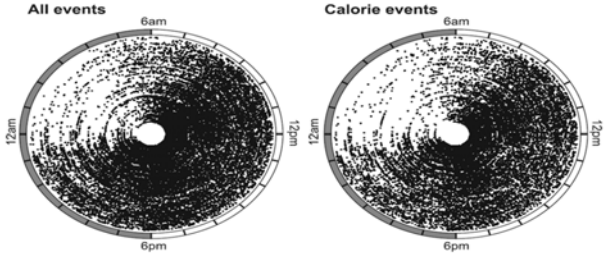
A Smartphone App Reveals Erratic Diurnal Eating Patterns in Humans that Can Be Modulated for Health Benefits





Cell Metabolism 2015, 22, 789–798.

Polar plot of all (C) or calorie-containing (≧5 kcal) (D) ingestion events of each individual plotted against the time of day (radial axis) in each concentric circle. Data from 156 individuals are shown.

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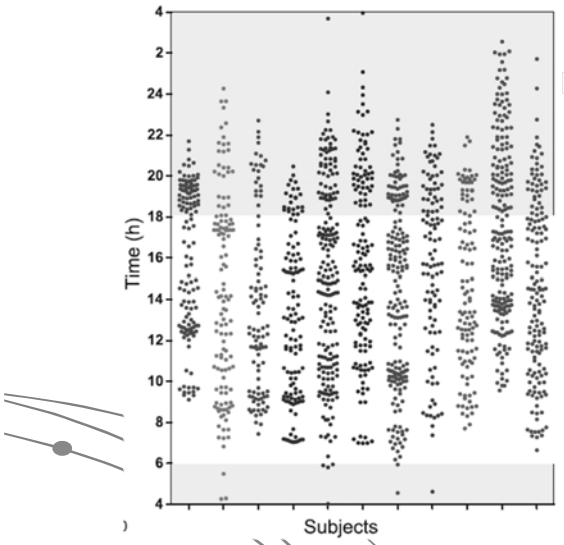
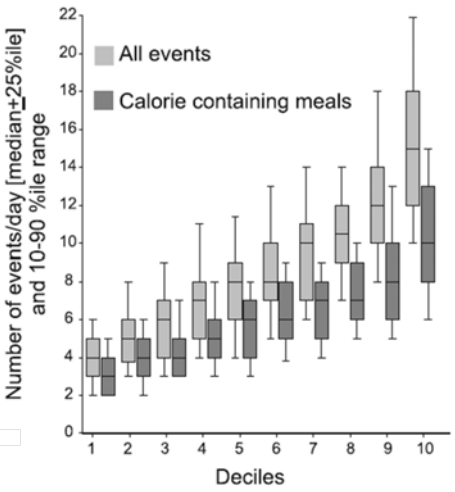
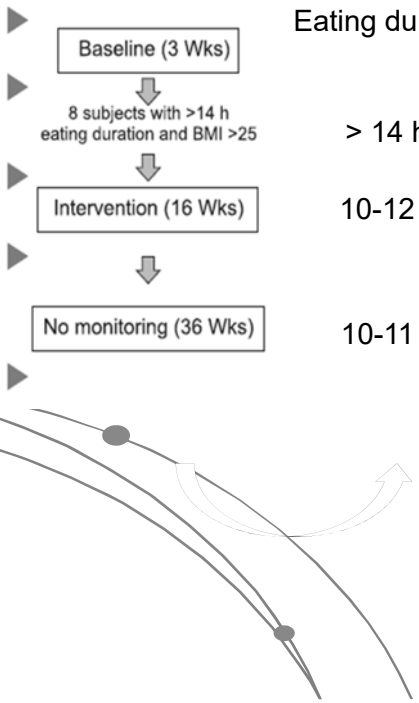


Representative scatter plot of ingestion events of 11 subjects during the observation period shows the lack of clustering of events into three principal bins for most individuals and a large variation in the total number of events



Number of ingestion events/day in all subjects binned into 10 deciles shows a wide distribution of number of total and calorie-containing events every day.

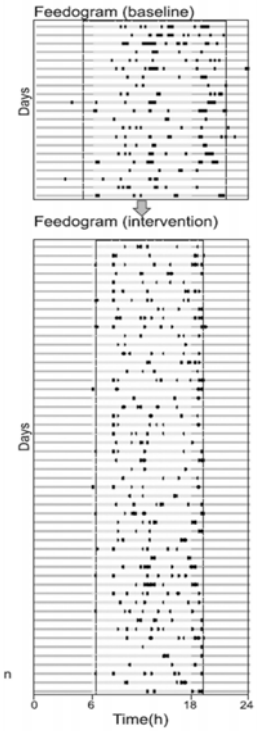


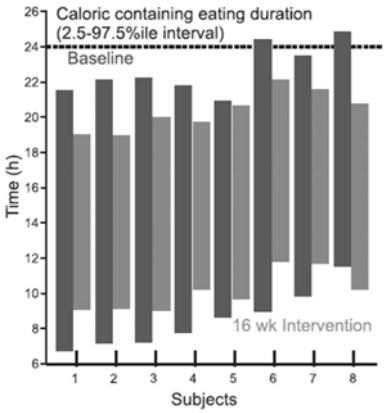
Eating duration

> 14 h

10-12 h

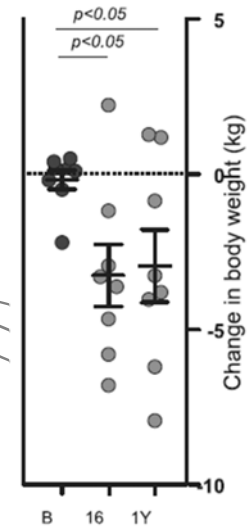
10-11 h



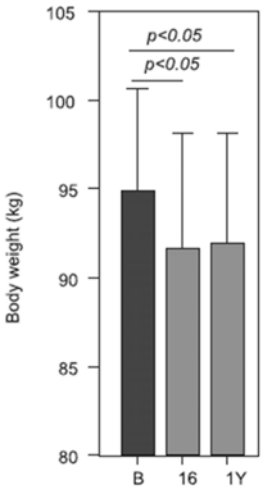


↓eating duration: 4 hr 35 min

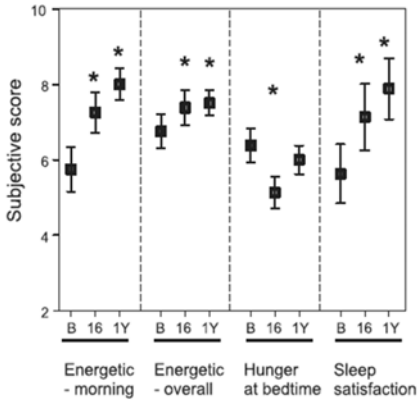
Average change in body weight



Average body weight



Average of subjective measures of energy level, hunger, and sleep in subjects



At 16 wk: mean wt loss 3.27 kg

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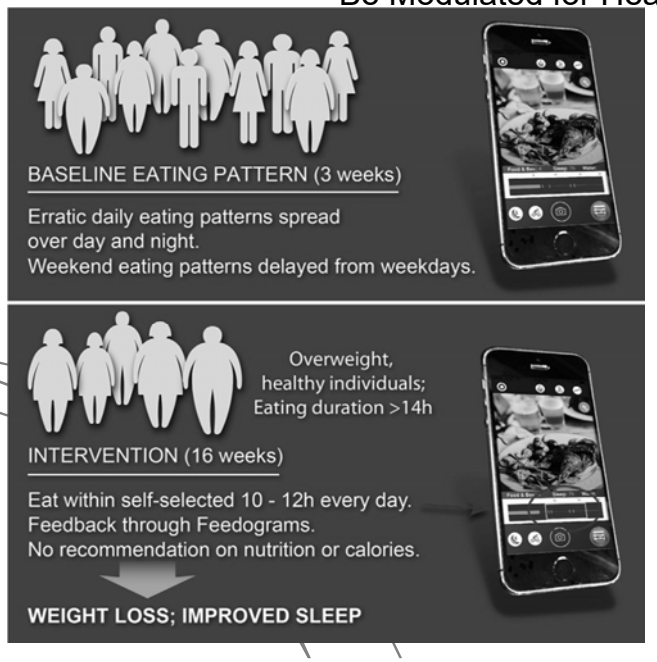
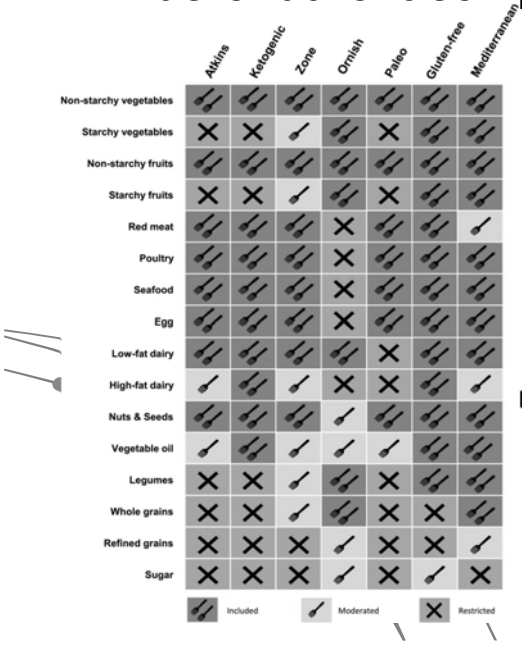
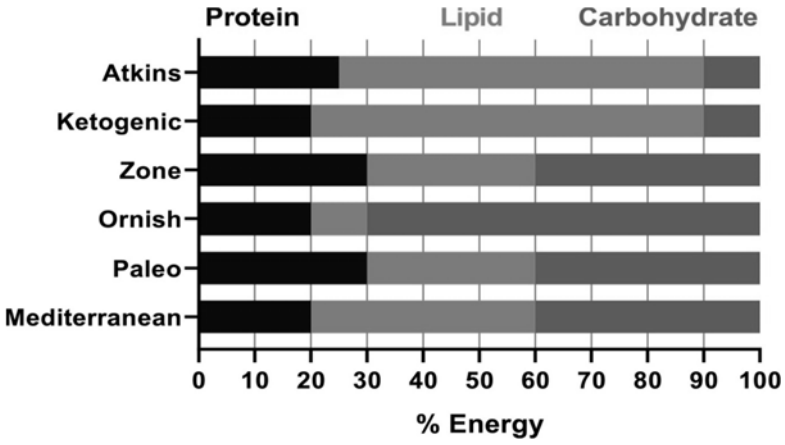


- The daily eating pattern in healthy adults is highly variable from day to day.
- More than half of the adults eat for 15 hr or longer every day.
- Sleep duration parallels the fasting duration.
- Reducing the daily eating duration can contribute to weight loss.

Cell Metabolism 2015, 22, 789–798.

Scientific evidence of diets for weight loss: Different macronutrient composition, intermittent fasting, and popular diets





Nutrition, 2020, 69, 110549.

WEIGHT-LOSS DIETS

Factors of success:

- **Adherence**
- **Negative energy balance**
- **High-quality foods**

Manipulation of macronutrient content

Low-fat, High-fat, High-protein, Low-carb

- Short-term: high-protein-low-carb (HP-LC) diets might present benefits
- HP-LC prescribed as jump-start with caution (adverse effects)
- Long-term: different ratio of macronutrients promotes similar weight loss (when associated with caloric restriction)

Manipulation of timing

Periodic fasting (5:2)
Alternate day fasting
Time-restricted feeding

- Some metabolic health benefits, but requires more evidence in humans
- May lead to over-eating
- Prescribed as jump-start with caution (adverse effects)
- Similar weight loss (when associated with caloric restriction)

Restriction of specific food and/or food group

Plant-based, Mediterranean, Gluten-free, Paleo

Plant-based:
- Some evidence of success
- Requires further long-term studies
- Requires effective counseling and adequate nutritional supplementation

Mediterranean:
- Based on high-quality foods
- Evidence of weight loss in short- and long-term
- Strong-evidence of health and metabolic benefits

Gluten-free:
- Gluten: ↑ intestinal permeability, dysbiosis, and ↑ inflammation
- Obesogenic properties in humans require further studies

Paleo:
- Some evidence of success for weight-loss
- Requires further long-term studies to support health benefits
- Potential risk of nutritional deficiencies

Conclusions

- 飲食的改變與減重仍為糖胖症治療很重要的一部份。
- 減重有助於血糖及心血管代謝指標的控制，對於過重或肥胖者，許多飲食策略可以達到體重減輕的目的。
- 鑑於糖尿病及糖尿病前期者眾，且文化背景、個人喜好、共病症、社經狀況不同，因此要求所謂一體適用的標準飲食型態來防治糖尿病是不切實際的。
- 什麼是抗糖或是減重的最佳飲食沒有一致共識，因此配合當地食物的可利用性及個人需求而調整的地中海飲食可作為糖尿病預防或治療的另一種飲食選項。

- 進食的時間與頻率也是另一個值得研究的有趣主題，它對於體內內分泌與代謝的影響仍需更多的研究。
- 每個人適合的飲食型態不同，價值觀念不同；沒有一種可以適合所有人的減重飲食。短時間高蛋白質限制熱量飲食具有快速的效果但需要注意不良反應。長時間減重，地中海飲食可以是一種選項。
- 最根本的原則：選擇可以長期遵循以健康食物為基礎的負熱量平衡的健康飲食。

THANKS FOR YOUR ATTENTION!