“Low carb” and “Good carb” diets: short- and long-term health effects

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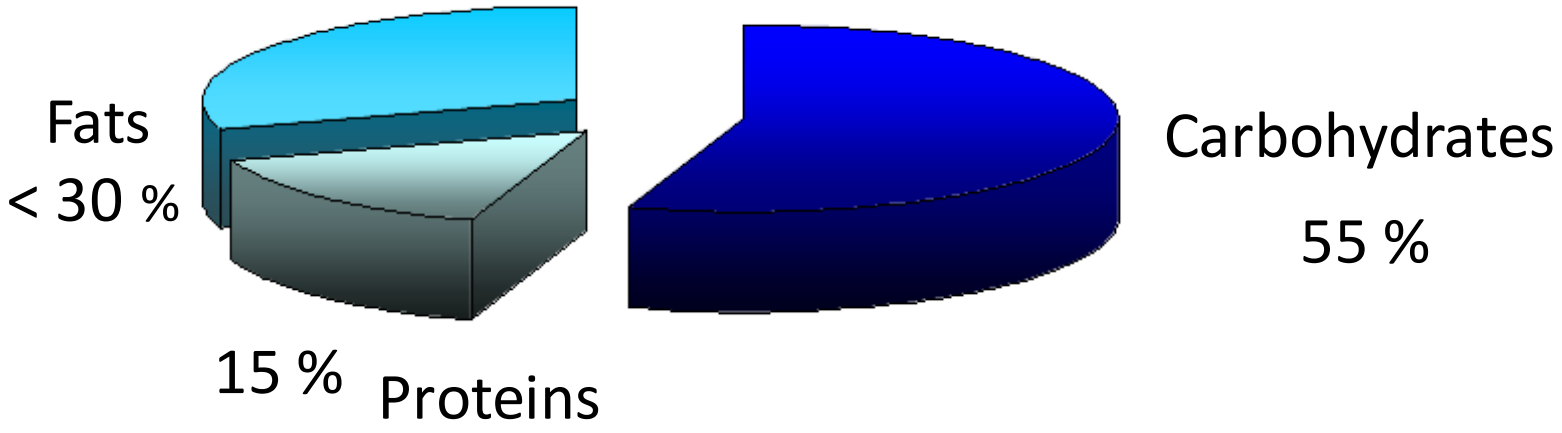
Low Carb Diet Definitons

A balanced diet should obtain calories from:



"Low Carb" diets typically obtain from Carbohydrates (CHO) *<30%* of calories. Protein and Fat derived calories are (dis)proportionally increased.

Most people follow low carb diets essentially because they want to lose weight.

Do Low Carb diets help to lose weight?

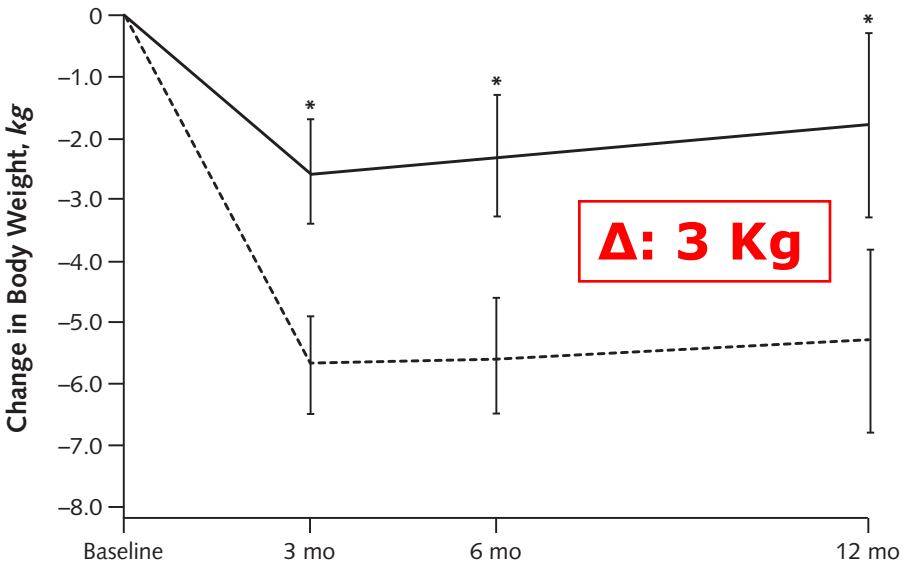
Yes

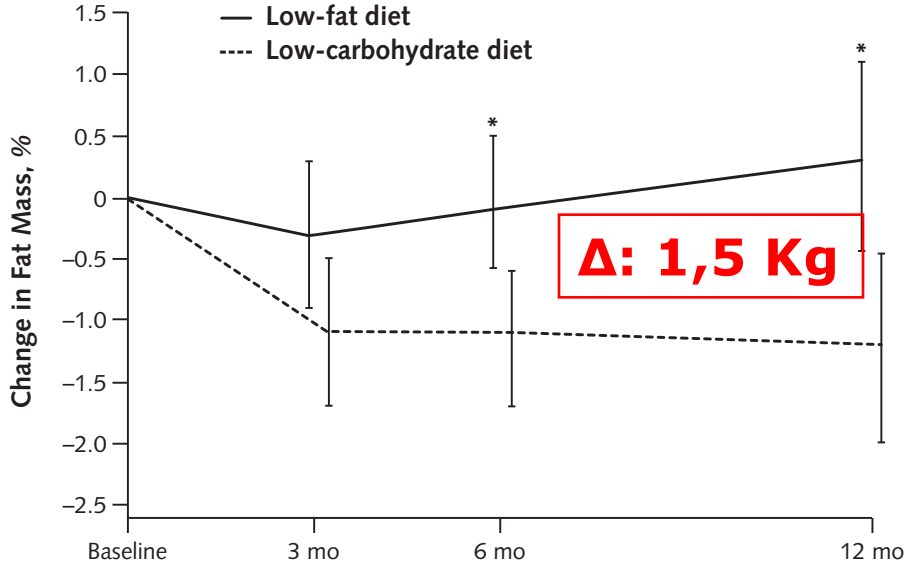
The global published evidence suggests that **low carb diets are effective** in helping people **to rapidly lose weight**.

They probably work because:

- They usually have a **high protein content (highly satiating)**
- They also induce a rapid Na^+ and water loss (N - excretion)
- They induce a **minimal rise of glucose after the meal** (the "Glycemic Response" is very low).

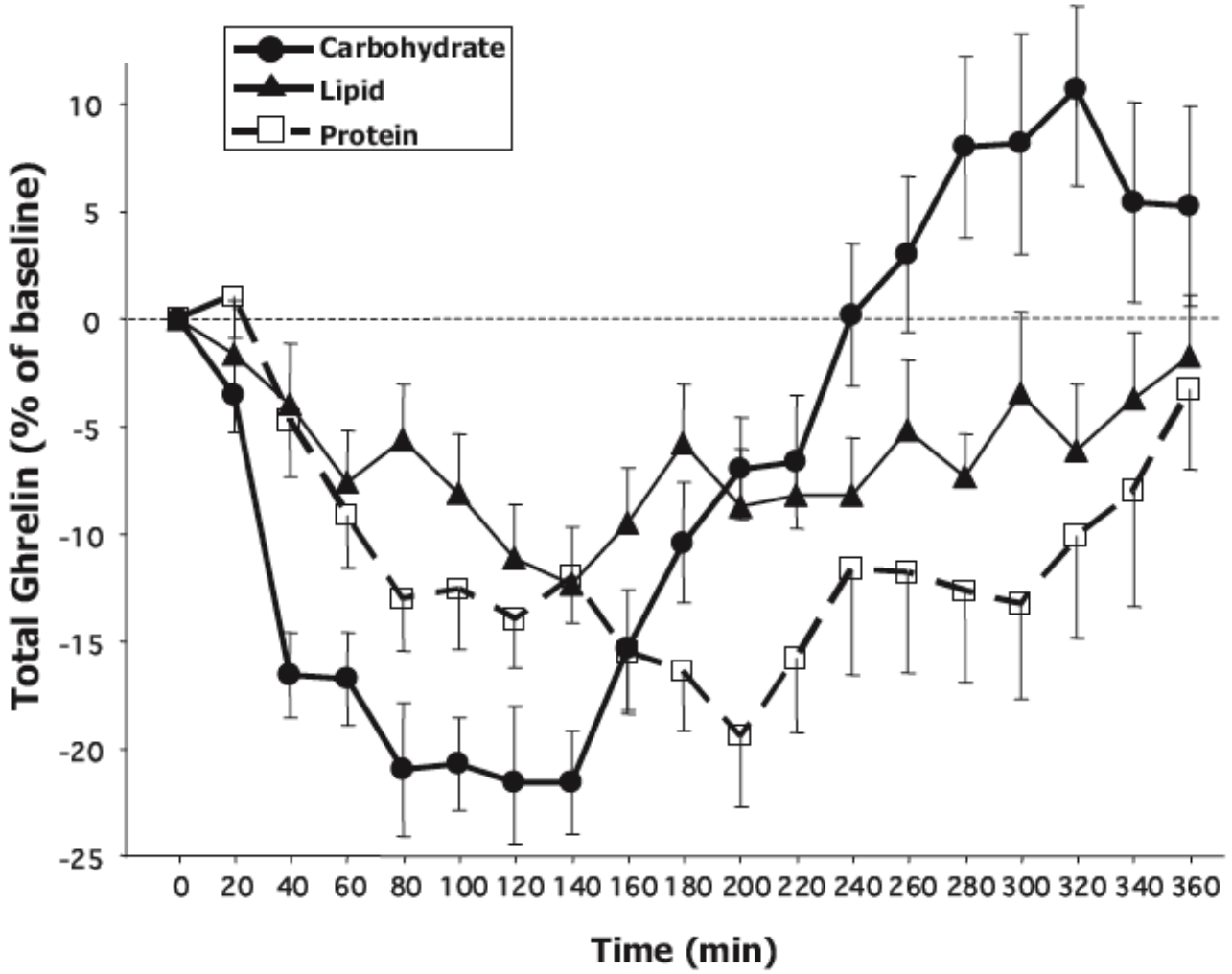
Low fat vs Low carb diets: a RCT. Effects on weight and fat mass





Bazzano AL et al, Ann Intern Med 2014

Effects of food rich in carbohydrates, lipids and proteins on ghrelin response



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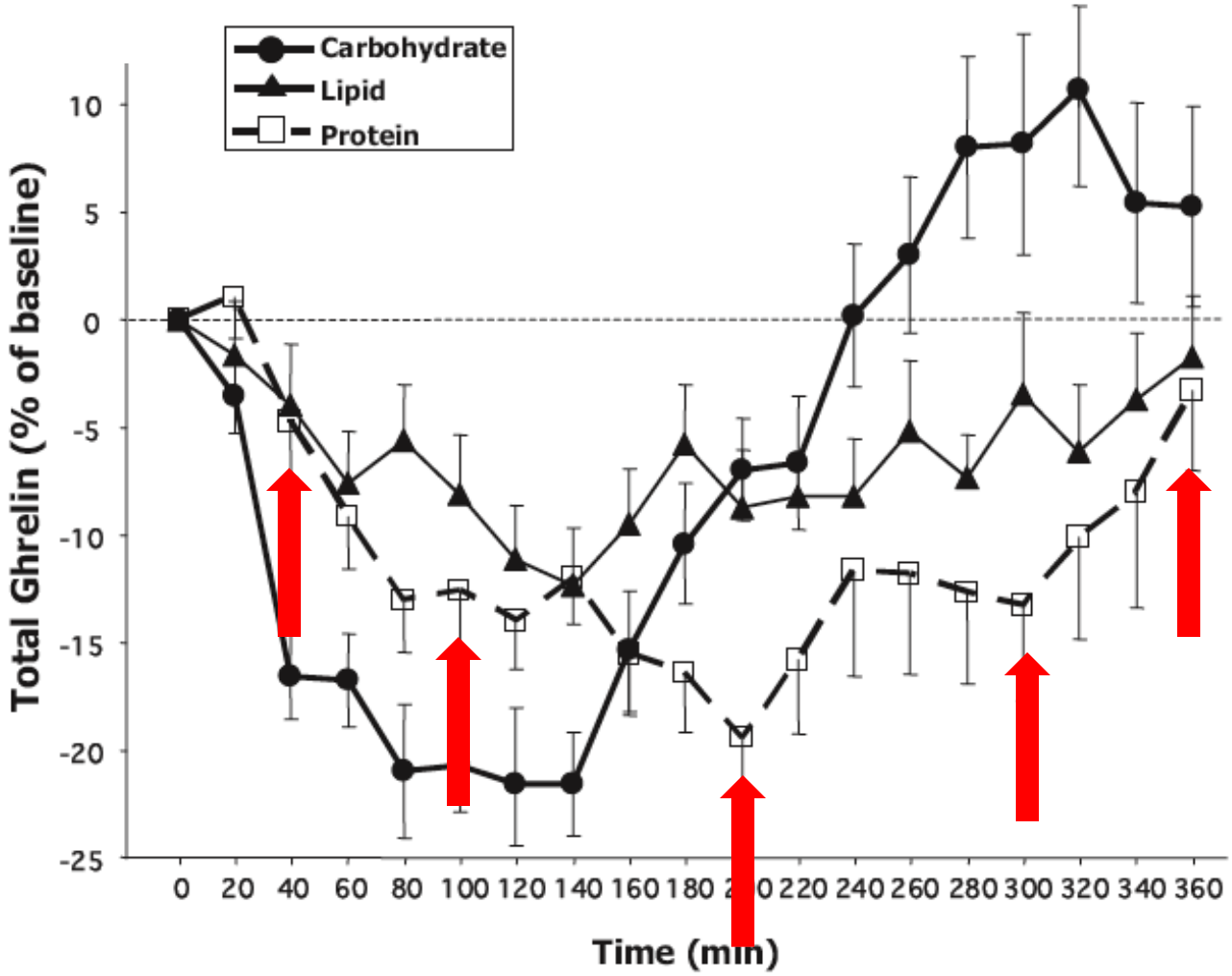

Foster-Schubert KE, JCEM 2008

Why is it important to keep the Glycemic Response low?

1. The **insulinemic response is reduced during low carb diets**, and it is thus **less probable** to develop hypoglicemia after the meal, and **to become hungry**
2. The body uses preferentially **fat** (instead of glucose) **for energy** production
3. Less blood sugar is converted into fat

Eventually, body weight decreases

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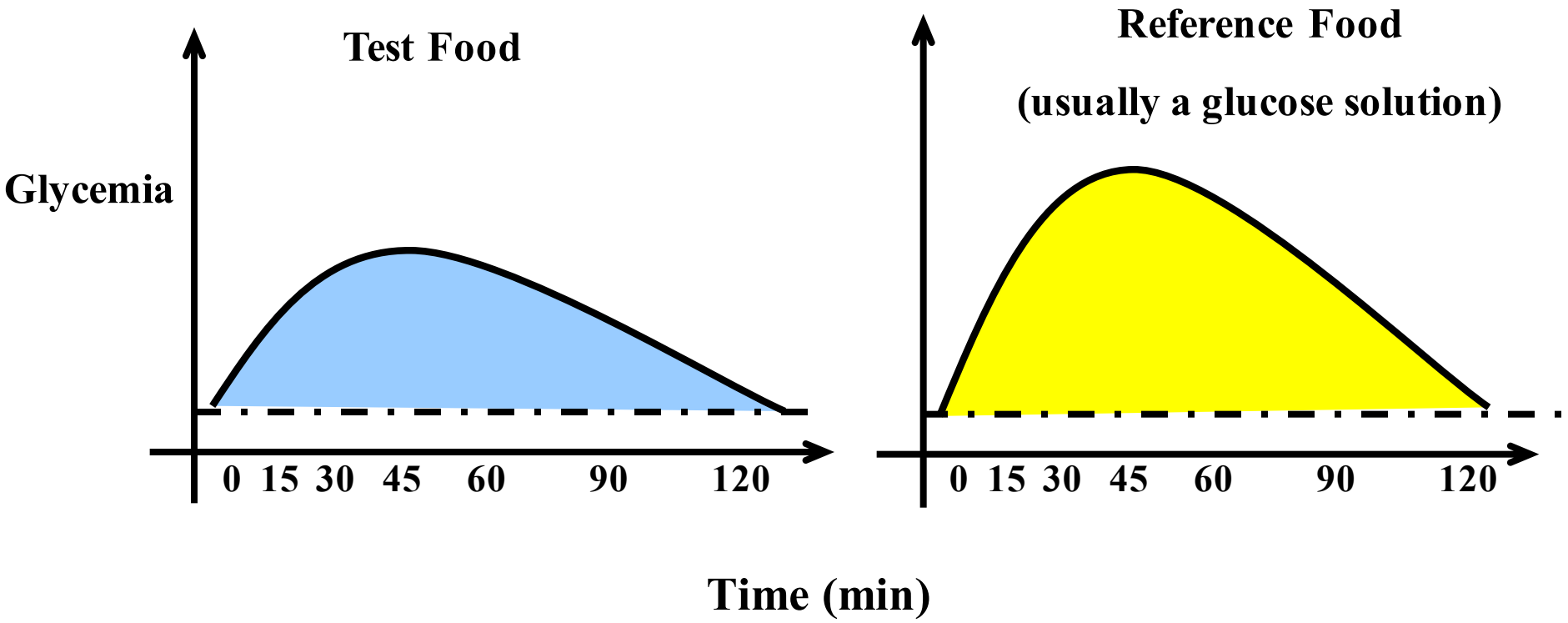
Are there other ways to keep the Glycemic Response low? Yes

If patients select the **proper carbohydrates ("good carbs")**, they will induce, like in the low carb diets, a **low glycemic response**

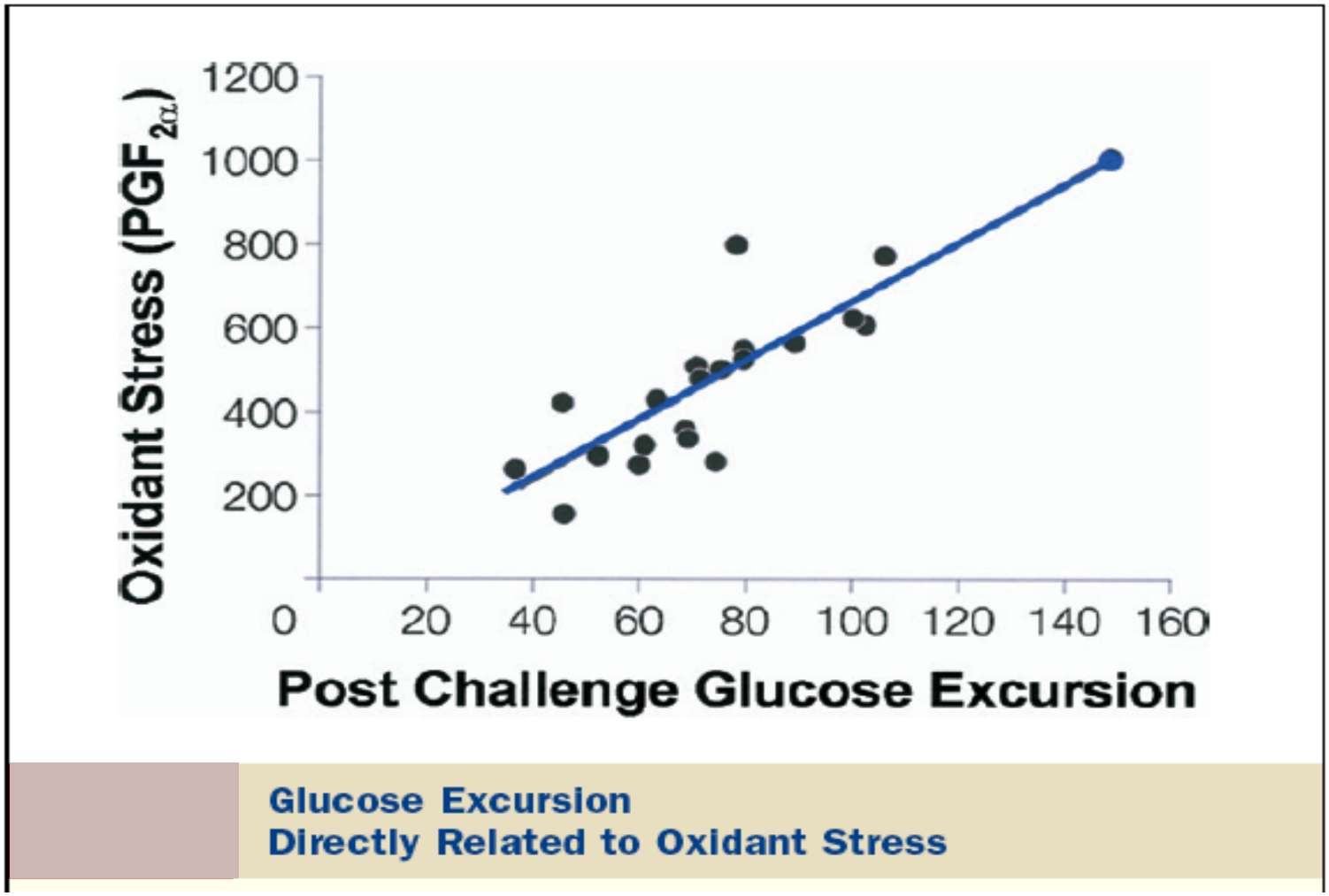
Glycemic Index (GI)

GI is a classification of carbohydrate rich foods based on their *blood glucose rising potential*.



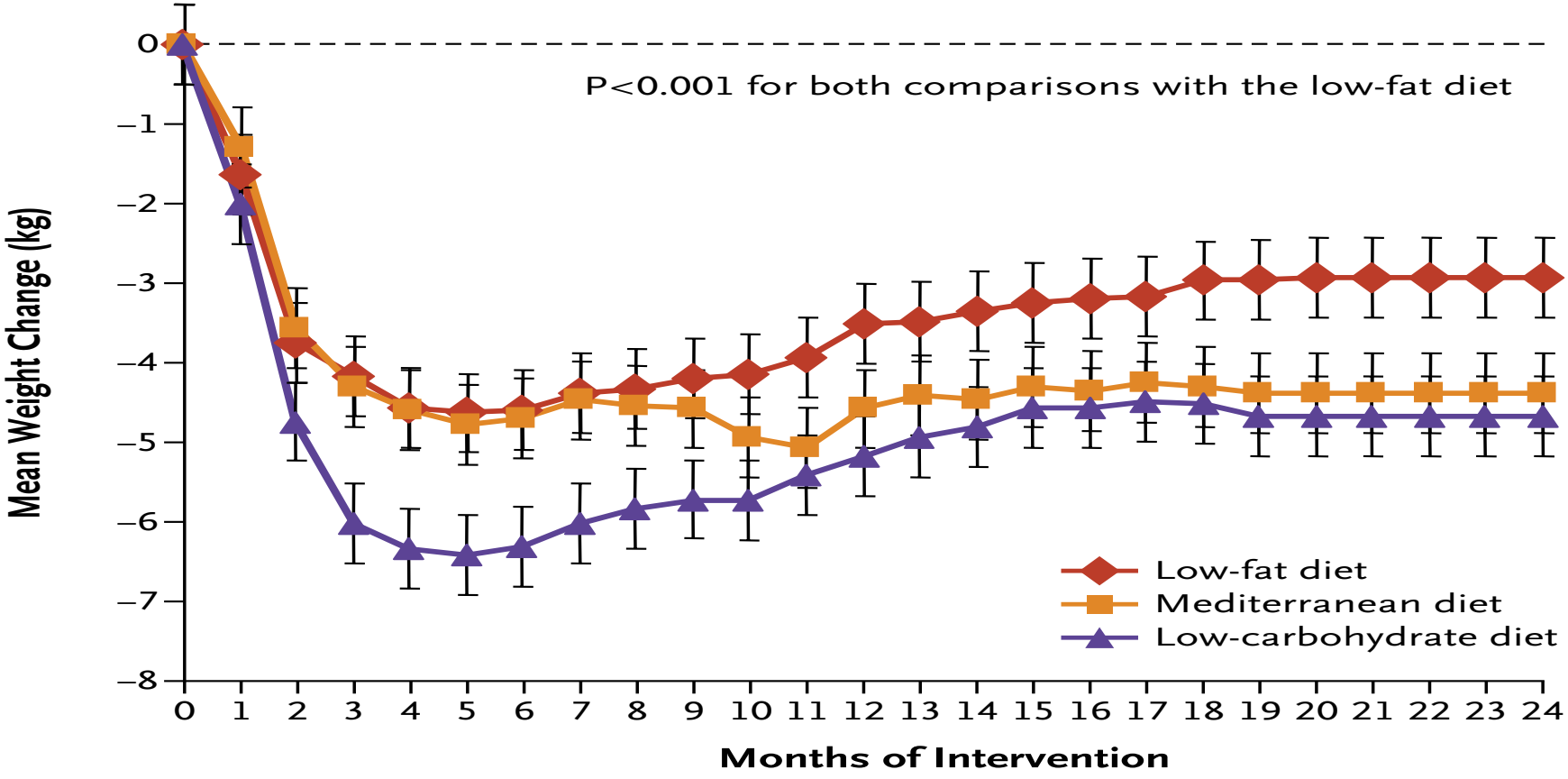
Jenkins et al. AJCN 1981; Wolever et al 1991

Post-prandial glucose excursions and urinary excretion of 8-iso PGF2 alfa, a measure of oxidant stress.

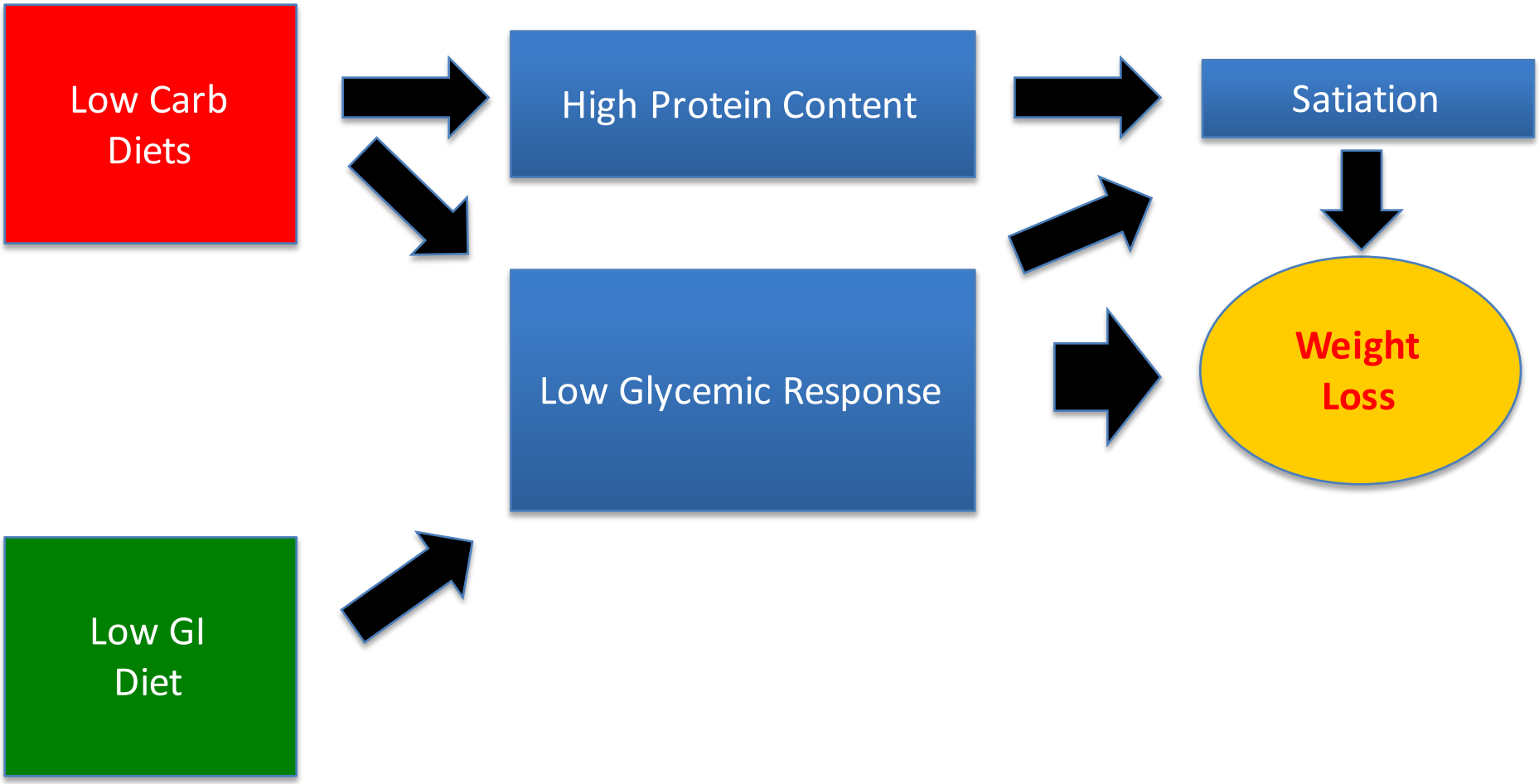


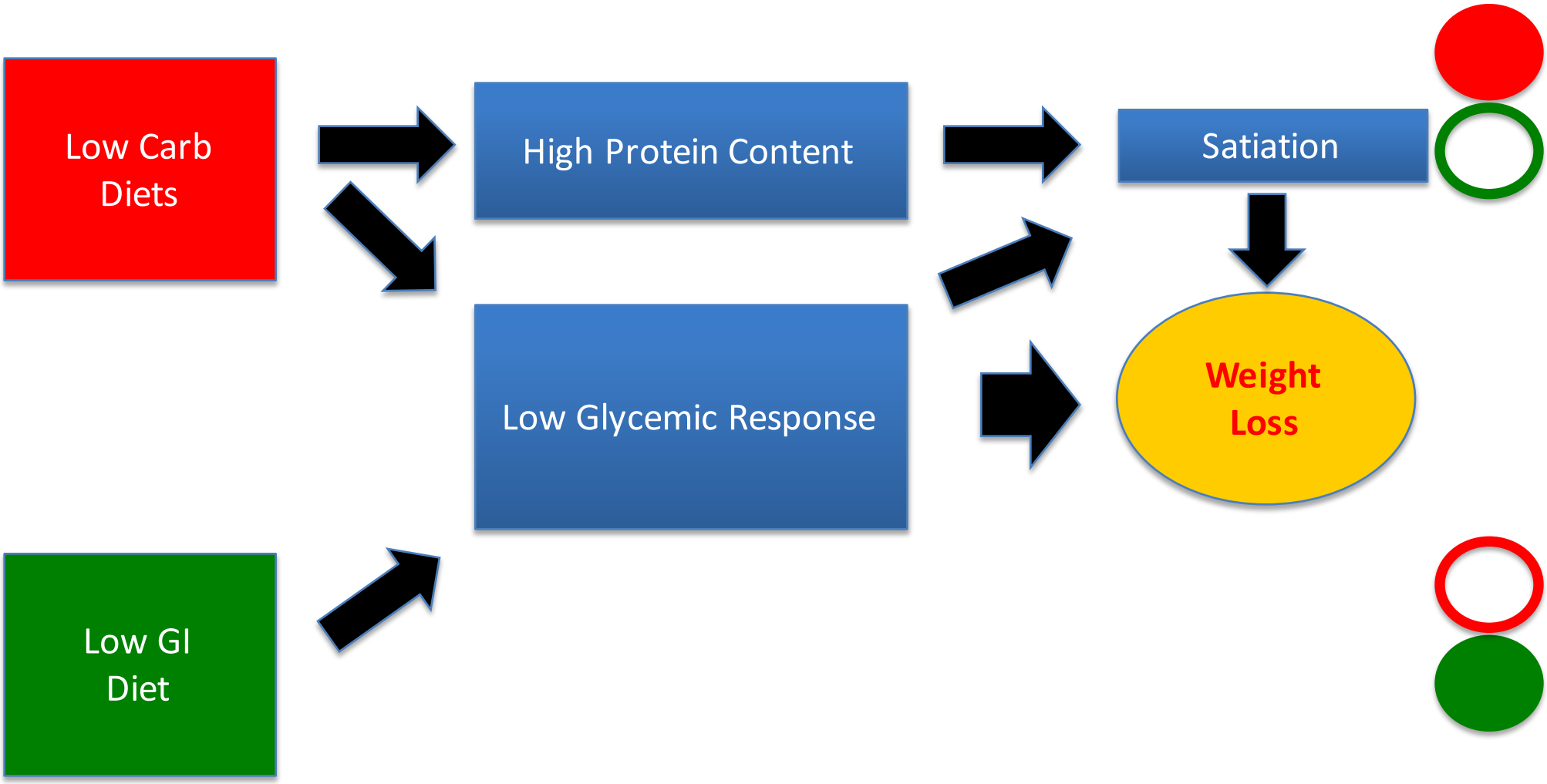
Monnier L et al, JAMA 2006

Med Diet is as effective as Low Carb diet in weight loss



Shai I et al, N Engl J Med 2008


Low Carb Diets
High Protein Content
Satiation
Low Glycemic Response
Weight Loss
Low GI Diet


Low Carb Diets
High Protein Content
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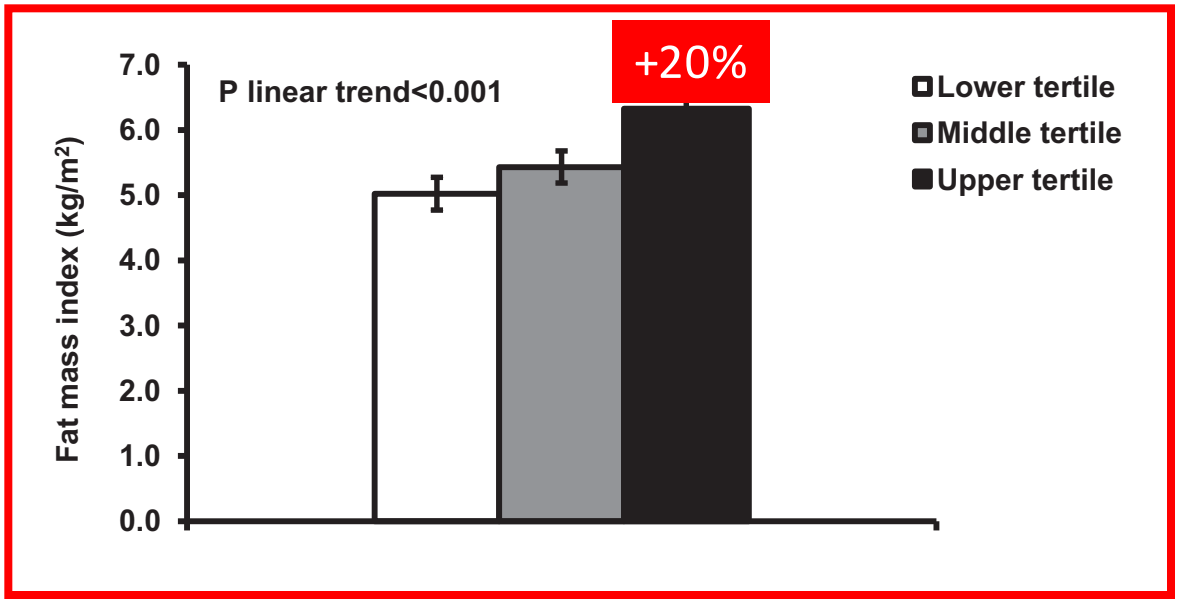
High fat diets are associated with higher abdominal adiposity regardless of physical activity in adolescents; the HELENA study

Idoia Labayen [a,*], Jonatan R. Ruiz [b,c], Francisco B. Ortega [b,c], Inge Huybrechts [d,e], Gerardo Rodríguez [f,g], David Jiménez-Pavón [g], Romana Roccaldo [h], Esther Nova [i], Kurt Widhalm [j], Anthony Kafatos [k], Dénés Molnar [l], Odysseas Androutsos [m], Luis A. Moreno [g,n]



Fat intake (% of total energy)

Clinical Nutrition, 2014

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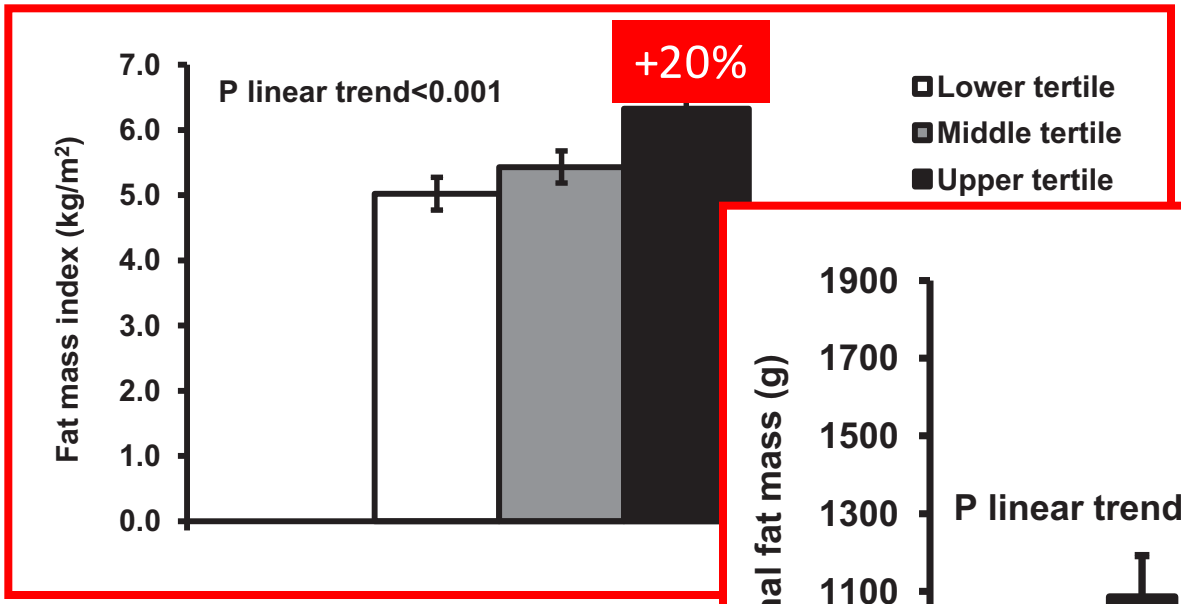
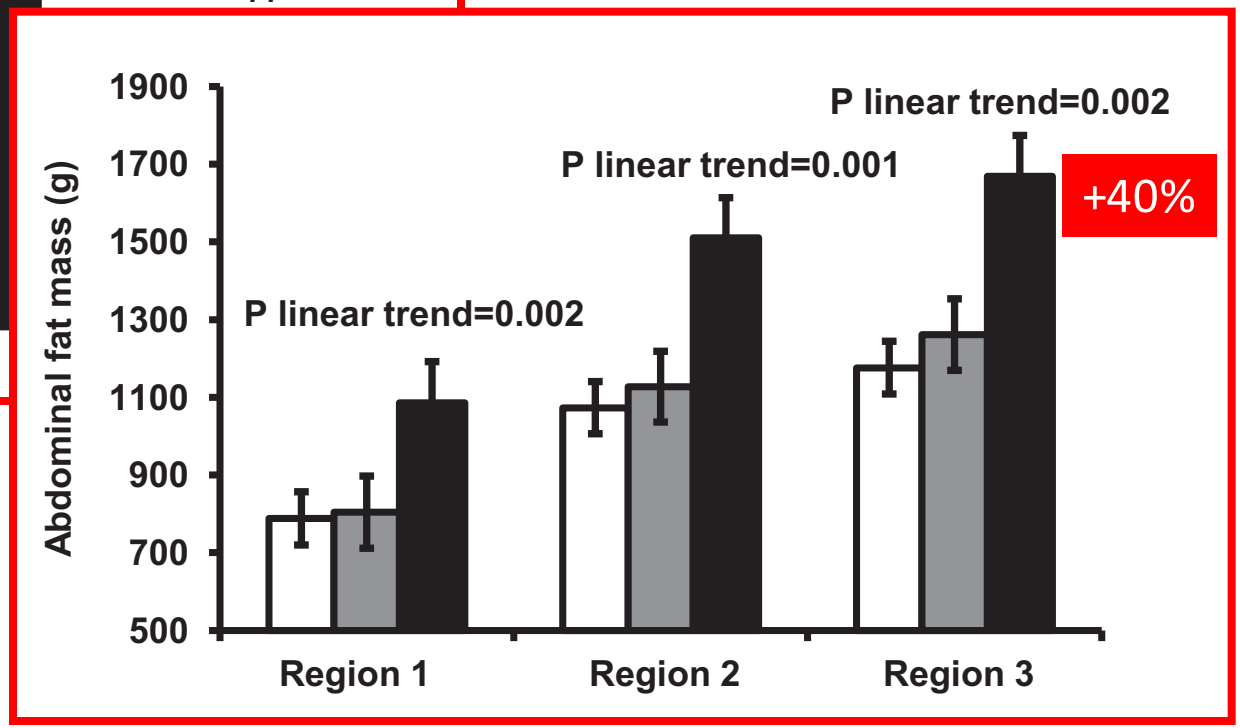


Fat intake (% of total



Clinical Nutrition, 2014

Low carbohydrate-high protein diet and incidence of cardiovascular diseases in Swedish women: prospective cohort study

Design: Prospective cohort study.

Setting: Uppsala, Sweden.

Participants: From a random population sample, 43 396 Swedish women, aged 30-49 years at baseline, completed an extensive dietary questionnaire

Follow-up: for an average of 15.7 years.

Lagiou P et al, BMJ 2012

Low carbohydrate-high protein diet and incidence of cardiovascular diseases in Swedish women: prospective cohort study

	Incidence rate ratios* (95% CI)		
Condition (No of cases)	Low carbohydrate score (per tenth)	High protein score (per tenth)	LCHP score (per 2 units)
All cardiovascular diseases (1268)	1.04 (1.00 to 1.08)	1.04 (1.02 to 1.06)	1.05 (1.02 to 1.08)
Ischaemic heart disease (701)	1.04 (0.99 to 1.09)	1.03 (1.00 to 1.06)	1.04 (1.00 to 1.08)
Ischaemic stroke (294)	1.05 (0.98 to 1.14)	1.05 (1.01 to 1.10)	1.07 (1.00 to 1.13)
Haemorrhagic stroke (70)	1.00 (0.86 to 1.17)	1.05 (0.96 to 1.14)	1.05 (0.93 to 1.18)
Subarachnoid haemorrhage (121)	1.07 (0.95 to 1.21)	1.05 (0.98 to 1.12)	1.07 (0.97 to 1.17)
Peripheral arterial disease (82)	1.04 (0.90 to 1.21)	1.04 (0.95 to 1.13)	1.04 (0.93 to 1.17)

LCHP=low carbohydrate-high protein.

Lagiou P et al, BMJ 2012

High total protein intake, cardiovascular diseases and all-cause deaths in the PREDIMED study

	Quintiles of cumulative average percentage of energy from total protein intake					
	Q1 (n = 1443)	Q2 (n = 1443)	Q3 (n = 1444)	Q4 (n = 1443)	Q5 (n = 1443)	P q-trend
Median (% of energy)	13.87	15.40	16.47	17.63	19.45	
Cardiovascular event, % (n)	4.9 (70)	3.4 (49)	3.9 (56)	3.0 (44)	4.0 (58)	
Person-years, n	6244	6325	6348	6190	5934	
Crude Model	1.27 (0.89, 1.80)	0.88 (0.60, 1.29)	1.00 (Referent)	0.80 (0.54, 1.19)	1.12 (0.77, 1.61)	0.03
Model 1	1.08 (0.74, 1.57)	0.82 (0.56, 1.22)	1.00 (Referent)	0.90 (0.60, 1.34)	1.31 (0.90, 1.91)	0.05
Model 2	0.89 (0.60, 1.33)	0.75 (0.51, 1.12)	1.00 (Referent)	0.91 (0.60, 1.37)	1.33 (0.88, 2.01)	0.16
Model 3	0.89 (0.59, 1.32)	0.75 (0.51, 1.11)	1.00 (Referent)	0.92 (0.61, 1.38)	1.38 (0.92, 2.07)	0.14
Cardiovascular death, % (n)	1.7 (24)	1.3 (19)	0.9 (13)	0.7 (10)	1.0 (15)	
Person-years, n	6333	6336	6173	6108	6129	
Crude Model	1.89 (0.96, 3.71)	1.46 (0.72, 2.97)	1.00 (Referent)	0.78 (0.34, 1.79)	1.25 (0.59, 2.62)	0.10
Model 1	1.25 (0.60, 2.60)	1.20 (0.59, 2.45)	1.00 (Referent)	0.98 (0.43, 2.24)	1.81 (0.85, 3.88)	0.13
Model 2	1.02 (0.47, 2.25)	1.08 (0.52, 2.27)	1.00 (Referent)	1.03 (0.44, 2.42)	2.09 (0.92, 4.78)	0.17
Model 3	1.03 (0.46, 2.30)	1.09 (0.52, 2.31)	1.00 (Referent)	1.03 (0.44, 2.42)	2.10 (0.93, 4.75)	0.16
Cancer death, % (n)	2.6 (37)	1.5 (22)	1.9 (27)	1.2 (17)	1.9 (27)	
Person-years, n	6333	6336	6173	6108	6129	
Crude Model	1.39 (0.85, 2.28)	0.82 (0.47, 1.44)	1.00 (Referent)	0.65 (0.36, 1.20)	1.10 (0.64, 1.87)	0.04
Model 1	1.09 (0.63, 1.87)	0.74 (0.42, 1.31)	1.00 (Referent)	0.76 (0.41, 1.41)	1.40 (0.80, 2.43)	0.05
Model 2	0.91 (0.51, 1.60)	0.69 (0.39, 1.22)	1.00 (Referent)	0.78 (0.42, 1.45)	1.48 (0.83, 2.67)	0.19
Model 3	0.80 (0.45, 1.43)	0.66 (0.37, 1.18)	1.00 (Referent)	0.77 (0.42, 1.44)	1.44 (0.80, 2.59)	0.21
All-cause death, % (n)	6.6 (95)	4.0 (57)	3.9 (57)	3.1 (45)	4.8 (69)	
Person-years, n	6333	6336	6173	6108	6129	
Crude Model	1.70 (1.23, 2.36)	1.00 (0.70, 1.45)	1.00 (Referent)	0.81 (0.55, 1.20)	1.31 (0.92, 1.87)	<0.001
Model 1	1.40 (0.98, 2.00)	0.91 (0.63, 1.32)	1.00 (Referent)	0.91 (0.62, 1.35)	1.61 (1.12, 2.32)	<0.001
Model 2	1.22 (0.84, 1.77)	0.88 (0.60, 1.28)	1.00 (Referent)	0.93 (0.63, 1.39)	1.59 (1.08, 2.35)	<0.001
Model 3	1.17 (0.80, 1.70)	0.86 (0.59, 1.25)	1.00 (Referent)	0.95 (0.64, 1.42)	1.66 (1.13, 2.43)	<0.001

Hernàndez-Alonso P et al, Clin Nutr 2015

High animal vs vegetable protein intake, cardiovascular diseases and all-cause deaths in the PREDIMED study

Animal Protein

	Quintiles of cumulative average percentage of energy from protein intake from different sources					
	Q1	Q2	Q3	Q4	Q5	*P* q-trend
	8.25	9.84	10.95	12.11	13.90	
Cardiovascular event, % (*n*)	4.7 (68)	3.6 (52)	3.1 (45)	3.7 (53)	4.1 (59)	
Crude Model	1.63 (1.12, 2.37)	1.18 (0.79, 1.77)	1.00 (Referent)	1.20 (0.81, 1.79)	1.44 (0.97, 2.12)	0.01
Model 2	1.13 (0.74, 1.71)	1.00 (0.67, 1.51)	1.00 (Referent)	1.45 (0.97, 2.19)	1.88 (1.23, 2.88)	0.02
Model 3	1.14 (0.74, 1.73)	1.01 (0.67, 1.52)	1.00 (Referent)	1.46 (0.97, 2.19)	1.88 (1.23, 2.86)	0.03
Cardiovascular death, % (*n*)	1.6 (23)	1.1 (16)	0.9 (13)	0.8 (11)	1.2 (18)	
Crude Model	1.92 (0.97, 3.79)	1.26 (0.61, 2.63)	1.00 (Referent)	0.85 (0.38, 1.91)	1.53 (0.75, 3.13)	0.03
Model 2	1.14 (0.53, 2.43)	0.90 (0.42, 1.92)	1.00 (Referent)	1.24 (0.54, 2.86)	3.06 (1.39, 6.74)	0.01
Model 3	1.17 (0.54, 2.52)	0.91 (0.43, 1.96)	1.00 (Referent)	1.23 (0.54, 2.83)	2.98 (1.36, 6.51)	0.02
Cancer death, % (*n*)	2.6 (38)	1.2 (17)	1.6 (23)	1.7 (24)	1.9 (28)	
Crude Model	1.78 (1.06, 2.99)	0.75 (0.40, 1.41)	1.00 (Referent)	1.06 (0.60, 1.88)	1.34 (0.77, 2.33)	0.01 (a)
Model 2	1.15 (0.64, 2.05)	0.61 (0.32, 1.16)	1.00 (Referent)	1.17 (0.65, 2.10)	1.85 (1.03, 3.34)	0.02
Model 3	1.03 (0.57, 1.85)	0.58 (0.31, 1.11)	1.00 (Referent)	1.23 (0.68, 2.21)	1.81 (1.00, 3.31)	0.04
All-cause death, % (*n*)	6.3 (91)	3.8 (55)	3.9 (56)	3.4 (49)	5.0 (72)	
Crude Model	1.76 (1.26, 2.45)	1.01 (0.69, 1.46)	1.00 (Referent)	0.88 (0.60, 1.3	1.42 (1.00, 2.01)	<0.001
Model 2	1.27 (0.87, 1.84)	0.88 (0.60, 1.29)	1.00 (Referent)	1.10 (0.74, 1.63)	1.86 (1.27, 2.73)	<0.001
Model 3	1.24 (0.86, 1.81)	0.88 (0.60, 1.29)	1.00 (Referent)	1.12 (0.76, 1.65)	1.92 (1.31, 2.82)	<0.001

Hernàndez-Alonso P et al, Clin Nutr 2015

High animal vs vegetable protein intake, cardiovascular diseases and all-cause deaths in the PREDIMED study

Vegetable Protein

	Quintiles of cumulative average percentage of energy from protein intake from different sources					
	Q1	Q2	Q3	Q4	Q5	*P* q-trend
%	4.48	5.06	5.49	5.94	6.59	
Cardiovascular event, % (*n*)	4.6 (66)	3.6 (52)	3.4 (49)	3.7 (54)	3.9 (56)	
Crude Model	1.29 (0.89, 1.87)	1.04 (0.70, 1.54)	1.00 (Referent)	1.16 (0.79, 1.71)	1.40 (0.96, 2.06)	0.05
Model 2	0.91 (0.60, 1.40)	0.94 (0.62, 1.41)	1.00 (Referent)	1.23 (0.82, 1.83)	1.36 (0.86, 2.15)	0.61
Model 3	0.84 (0.55, 1.29)	0.91 (0.60, 1.36)	1.00 (Referent)	1.24 (0.83, 1.85)	1.38 (0.88, 2.17)	0.74
Cardiovascular death, % (*n*)	1.4 (20)	1.0 (15)	1.5 (21)	1.0 (14)	0.8 (11)	
Crude Model	0.89 (0.48, 1.64)	0.71 (0.36, 1.37)	1.00 (Referent)	0.71 (0.36, 1.39)	0.66 (0.32, 1.37)	0.69
Model 2	0.52 (0.25, 1.07)	0.56 (0.28, 1.14)	1.00 (Referent)	0.78 (0.38, 1.59)	0.73 (0.30, 1.75)	0.14
Model 3	0.45 (0.22, 0.95)	0.57 (0.28, 1.15)	1.00 (Referent)	0.80 (0.39, 1.63)	0.78 (0.32, 1.88)	0.22
Cancer death, % (*n*)	2.9 (42)	1.4 (20)	1.4 (20)	1.6 (23)	1.7 (25)	
Crude Model	2.04 (1.19, 3.48)	0.98 (0.52, 1.81)	1.00 (Referent)	1.22 (0.67, 2.22)	1.60 (0.89, 2.89)	0.003
Model 2	1.82 (1.01, 3.30)	0.96 (0.50, 1.82)	1.00 (Referent)	1.31 (0.71, 2.42)	1.37 (0.69, 2.72)	0.05
Model 3	1.84 (1.01, 3.35)	0.96 (0.51, 1.82)	1.00 (Referent)	1.30 (0.70, 2.40)	1.39 (0.70, 2.75)	0.04
All-cause death, % (*n*)	6.1 (88)	4.0 (57)	4.2 (60)	3.7 (54)	4.4 (64)	
Crude Model	1.38 (0.99, 1.92)	0.93 (0.65, 1.34)	1.00 (Referent)	0.96 (0.66, 1.[illegible])	1.36 (0.96, 1.94)	0.003
Model 2	1.04 (0.72, 1.52)	0.86 (0.59, 1.25)	1.00 (Referent)	1.01 (0.70, 1.[illegible])	1.28 (0.84, 1.94)	0.16
Model 3	1.02 (0.70, 1.49)	0.85 (0.58, 1.24)	1.00 (Referent)	1.01 (0.70, 1.48)	1.32 (0.88, 2.00)	0.14

Hernàndez-Alonso P et al, Clin Nutr 2015

High animal vs vegetable protein intake, cardiovascular diseases and all-cause deaths in the PREDIMED study

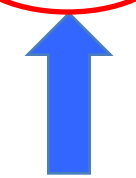
5. Conclusions

Taken together, the results of our study do not support the generalized use of high protein diets as a tool for better weight control in the long term and indicate that in middle-aged subjects or older adults these diets can have potentially adverse health consequences related to cardiovascular disease and cancer. There is a huge need for further molecular and clinical studies to elucidate the mechanisms by which the quantity and source of protein can differentially affect body composition and fatal and non-fatal outcomes, before recommend a high protein intake for a long-term.

Hernàndez-Alonso P et al, Clin Nutr 2015

Carbohydrates, fats and CHD risk in two US cohort studies

Total carbohydrates						
NHS						
Median, %E	34.7	41.7	45.8	49.4	54.5	
No. of cases	560	647	705	740	840	
Age-adjusted	1 (Ref.)	0.94 (0.84-1.05)	0.90 (0.81-1.01)	0.85 (0.76-0.96)	0.84 (0.75-0.94)	0.0009
Multivariable*	1 (Ref.)	1.02 (0.90-1.14)	1.03 (0.91-1.17)	1.03 (0.90-1.17)	1.09 (0.94-1.25)	0.26
HPFS						
Median, %E	38.7	44.6	48.5	52.3	58.1	
No. of cases	818	780	848	857	877	
Age-adjusted	1 (Ref.)	0.93 (0.84-1.02)	0.95 (0.86-1.05)	0.91 (0.83-1.00)	0.88 (0.80-0.97)	0.009
Multivariable*	1 (Ref.)	0.98 (0.88-1.08)	1.02 (0.92-1.14)	0.99 (0.89-1.11)	1.00 (0.88-1.14)	0.92
Pooled						
Multivariable*	1 (Ref.)	0.99 (0.92-1.07)	1.02 (0.94-1.11)	1.01 (0.92-1.10)	1.04 (0.94-1.14)	0.41



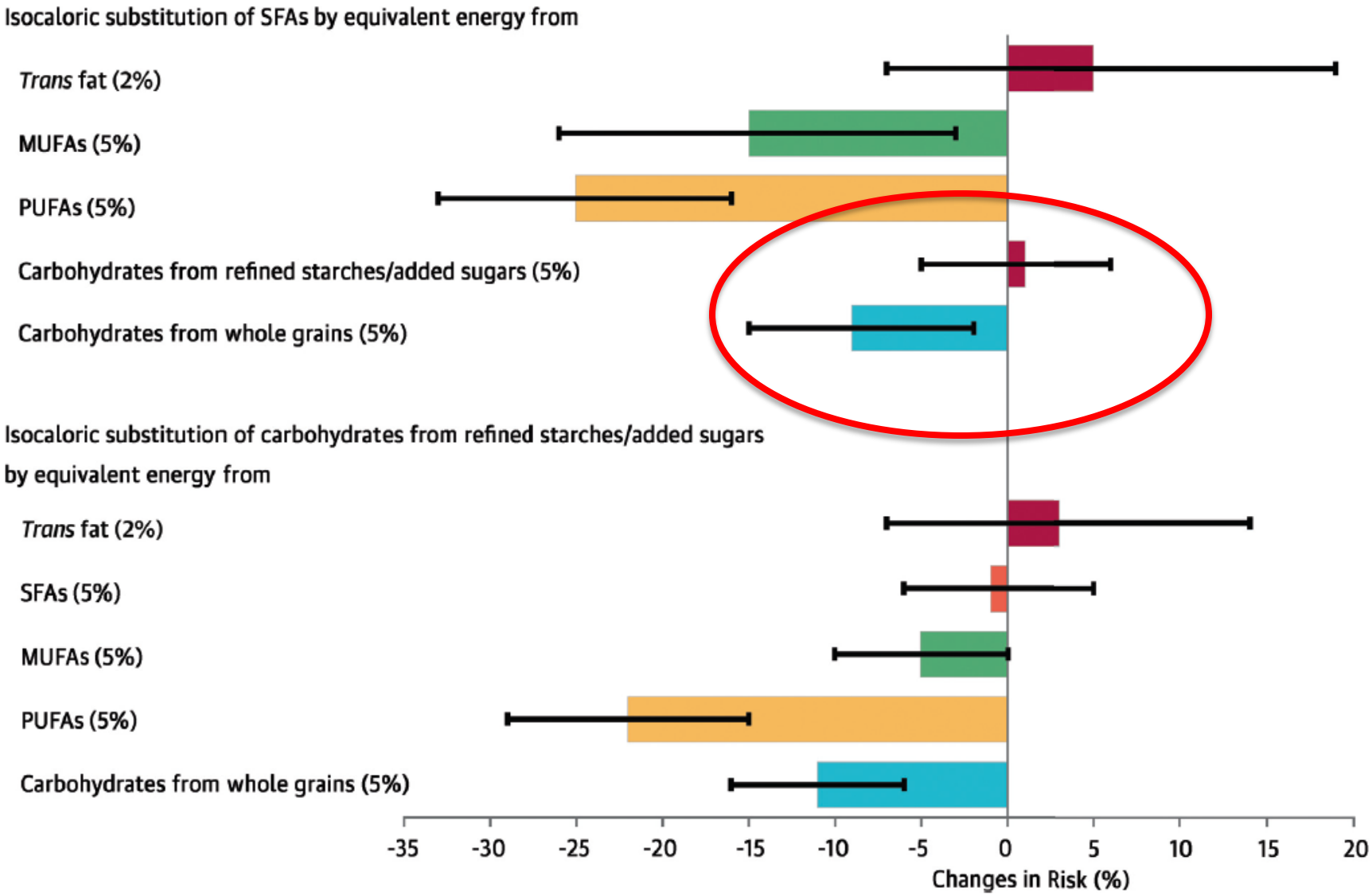
Li J et al, JACC 2015

Carbohydrates, fats and CHD risk in two US cohort studies

Carbohydrates from refined starches/added sugars						
NHS						
Median, %E	14.8	19.4	22.5	25.5	30.3	
No. of cases	594	683	712	762	741	
Age-adjusted	1 (Ref.)	1.00 (0.89-1.11)	1.03 (0.92-1.15)	1.14 (1.02-1.28)	1.24 (1.11-1.39)	<0.0001
Multivariable*	1 (Ref.)	1.01 (0.90-1.14)	1.02 (0.90-1.15)	1.10 (0.96-1.25)	1.10 (0.95-1.28)	0.15
HPFS						
Median, %E	16.7	20.9	23.8	26.8	31.6	
No. of cases	849	836	833	824	833	
Age-adjusted	1 (Ref.)	1.00 (0.91-1.10)	1.04 (0.95-1.15)	1.07 (0.97-1.18)	1.21 (1.10-1.33)	<0.0001
Multivariable*	1 (Ref.)	1.02 (0.93-1.13)	1.04 (0.94-1.16)	1.04 (0.93-1.16)	1.10 (0.97-1.25)	0.15
Pooled						
Multivariable*	1 (Ref.)	1.02 (0.95-1.10)	1.03 (0.95-1.12)	1.06 (0.98-1.16)	1.10 (1.00-1.21)	0.04
Carbohydrates from whole grains						
NHS						
Median, %E	0.4	1.0	1.8	2.8	4.6	
No. of cases	598	731	680	715	768	
Age-adjusted	1 (Ref.)	0.95 (0.85-1.06)	0.74 (0.66-0.83)	0.67 (0.60-0.76)	0.62 (0.55-0.69)	<0.0001
Multivariable*	1 (Ref.)	1.05 (0.94-1.18)	0.90 (0.80-1.01)	0.90 (0.79-1.02)	0.92 (0.81-1.05)	0.08
HPFS						
Median, %E	0.8	2.0	3.1	4.4	7.0	
No. of cases	895	868	820	840	752	
Age-adjusted	1 (Ref.)	0.94 (0.85-1.03)	0.82 (0.74-0.90)	0.80 (0.73-0.88)	0.69 (0.63-0.76)	<0.0001
Multivariable*	1 (Ref.)	1.03 (0.93-1.13)	0.96 (0.87-1.07)	0.99 (0.90-1.10)	.88 (0.79-0.99)	0.01
Pooled						
Multivariable*	1 (Ref.)	1.04 (0.96-1.11)	0.94 (0.87-1.01)	0.95 (0.88-1.03)	0.90 (0.83-0.98)	0.003

Li J et al, JACC 2015

Saturated fats compared with unsaturated fats and sources of carbohydrates in relation to risk of CHD



Li J et al, JACC 2015

In conclusion:

- Low carb diets are effective in inducing a rapid reduction in body weight
- This is associated with unfavourable metabolic effects and possible increase in CVD or All-Cause Death risk
- Such negative effects are partly due to fats, and partly to proteins, both increased in low carb diets
- “Good carb” diets exert, in the middle term, similar effects on BW, but with favourable associated metabolic effects if low GI, whole grain, carbs are preferred

In conclusion:

- ***"Good carb" diets should definitevely be preferred to "Low carb diets"***