Healthy Metabolism: Why Moderate Amounts of Healthy Carbohydrates and Fats Trump "Low Fat"

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What do we want from our metabolism?

- Help in maintaining a healthy weight
- Healthy lipids:
  - low cholesterol (LDL),
  - high HDL
  - low triglycerides (blood fat)
- Normal blood sugar

How can we maintain a healthy weight?

Don’t eat more calories than we burn !!

What do we burn?

- Under resting conditions, we burn about equal amounts of fat and carbohydrate, and less protein

- Shorter, more intense exercise: more carb

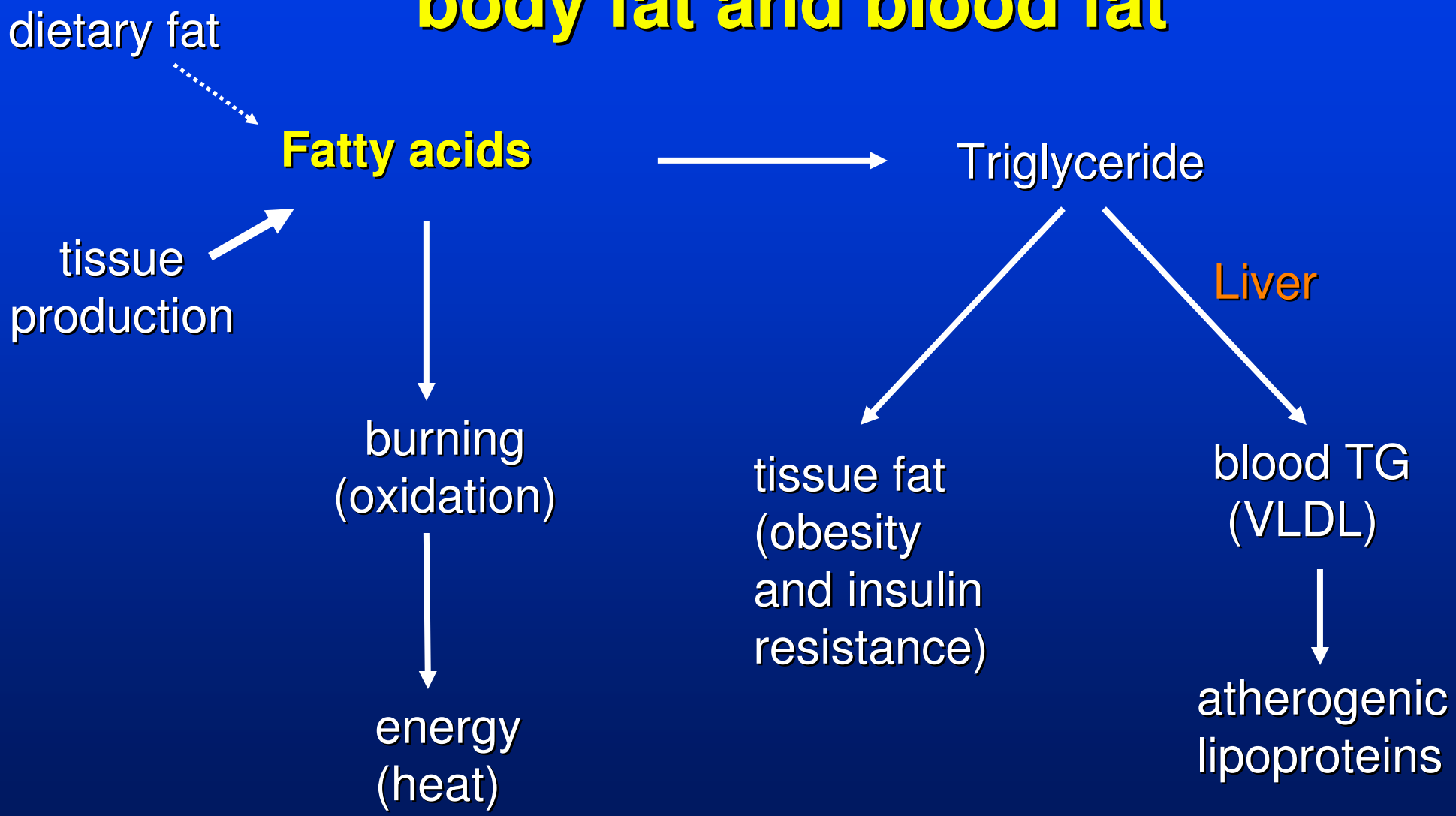
  Sustained exercise: more fat - greater impact on weight

Can diet promote metabolic fitness and help burn more fat?

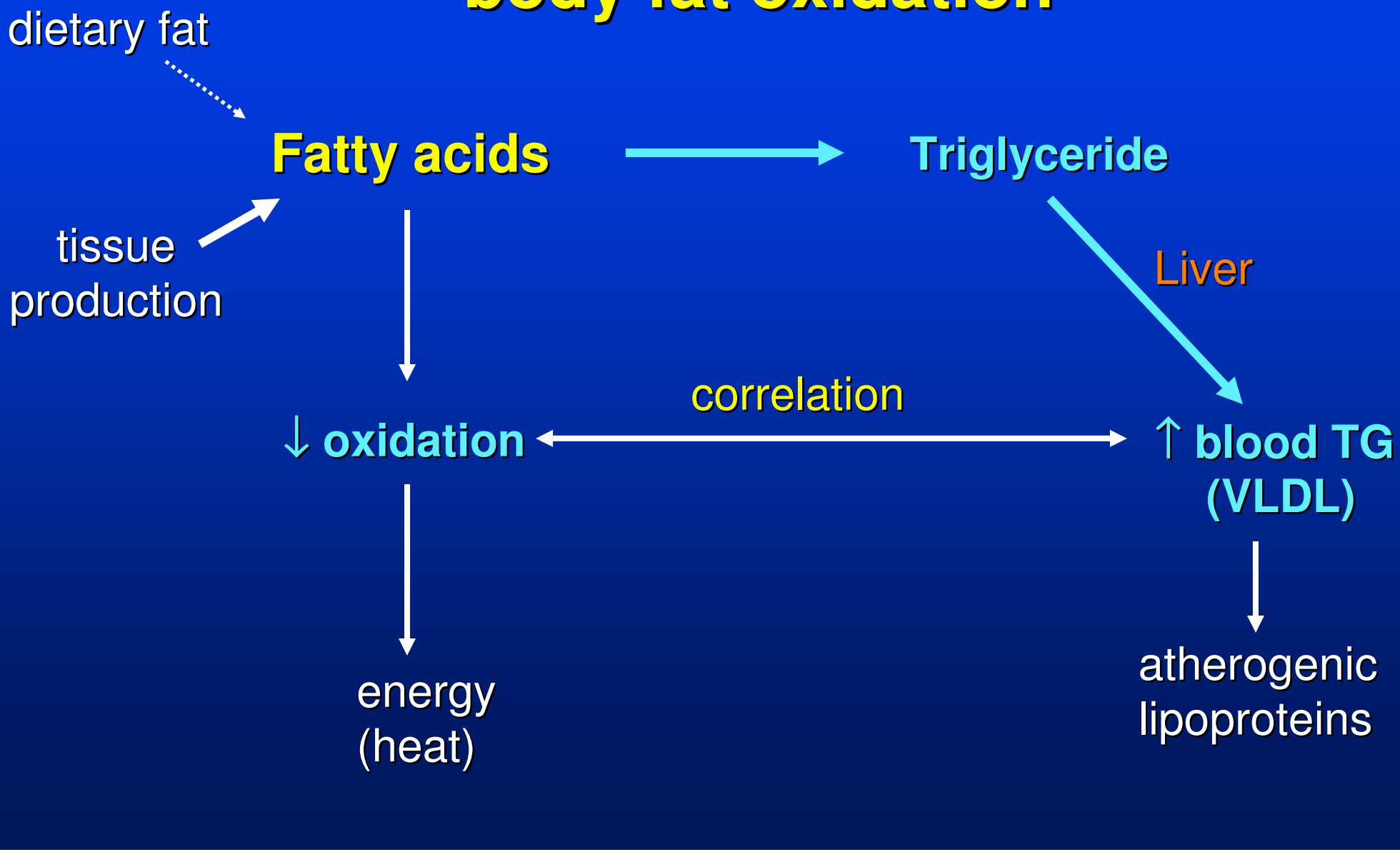
Diet and “Metabolic Fitness”: Fat and Sugar Metabolism 101

- Most fat is made in the liver
- Excess fat can be
  - burned,
  - released into the blood (high triglyceride),
  - or stored (--> fatty liver)

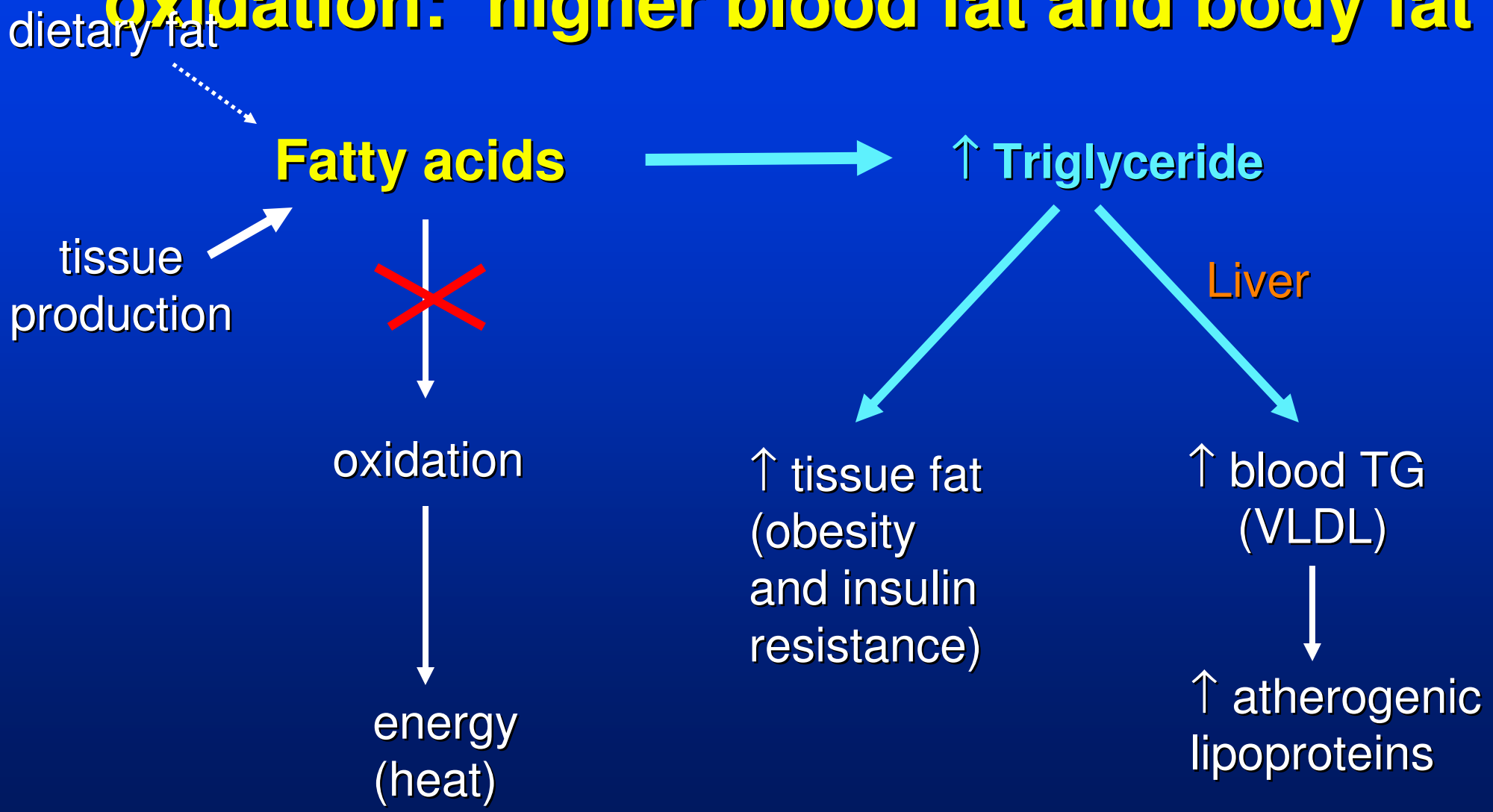
Fatty acids are a key link between body fat and blood fat



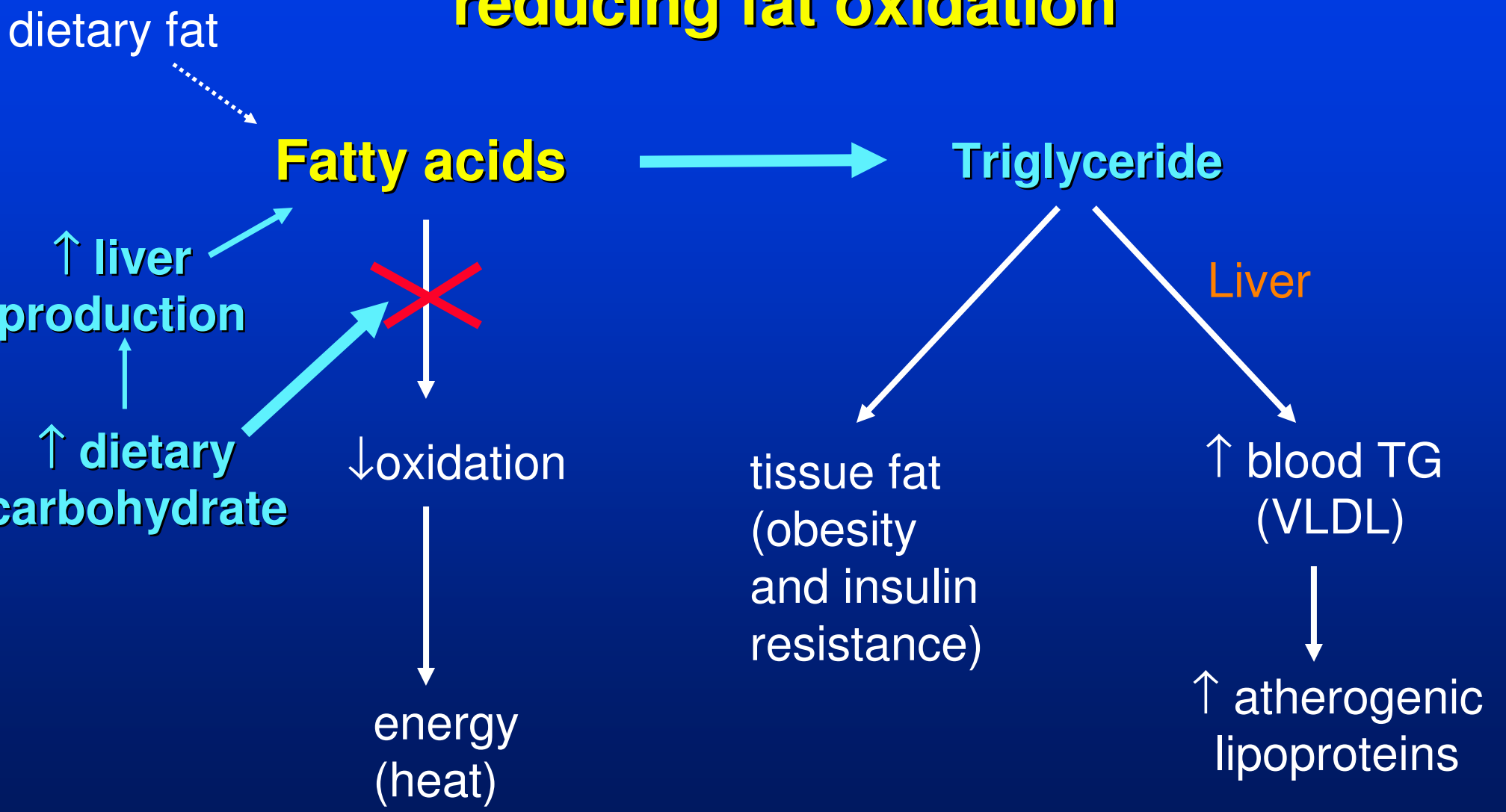
Higher blood fat is linked to lower body fat oxidation



Dietary carbohydrate reduces fatty acid oxidation: higher blood fat and body fat



Increased carbohydrate intake increases liver fat synthesis, and has an even greater effect in reducing fat oxidation



Schwarz et al, J Clin Invest 36:2735, 1995

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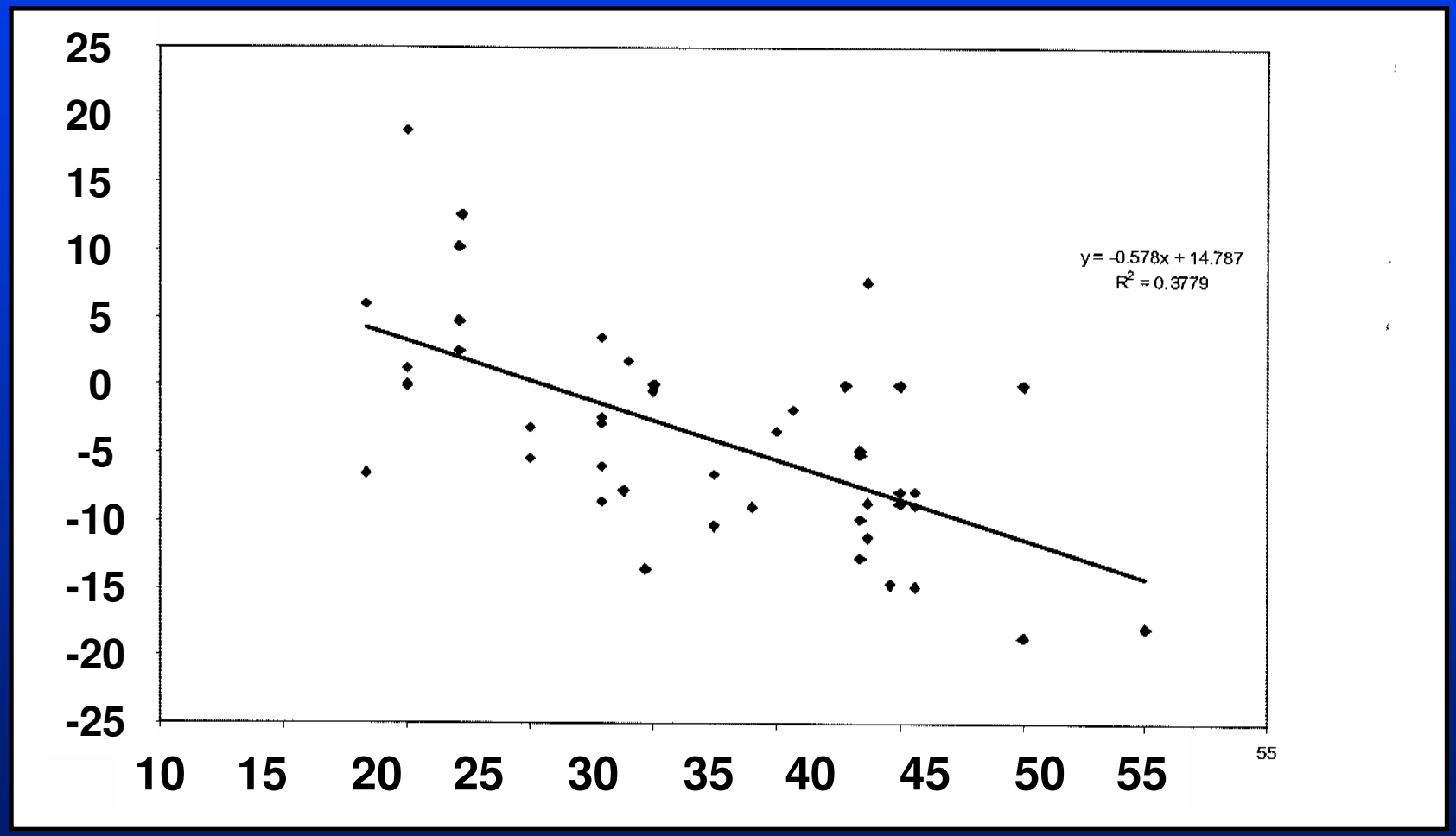
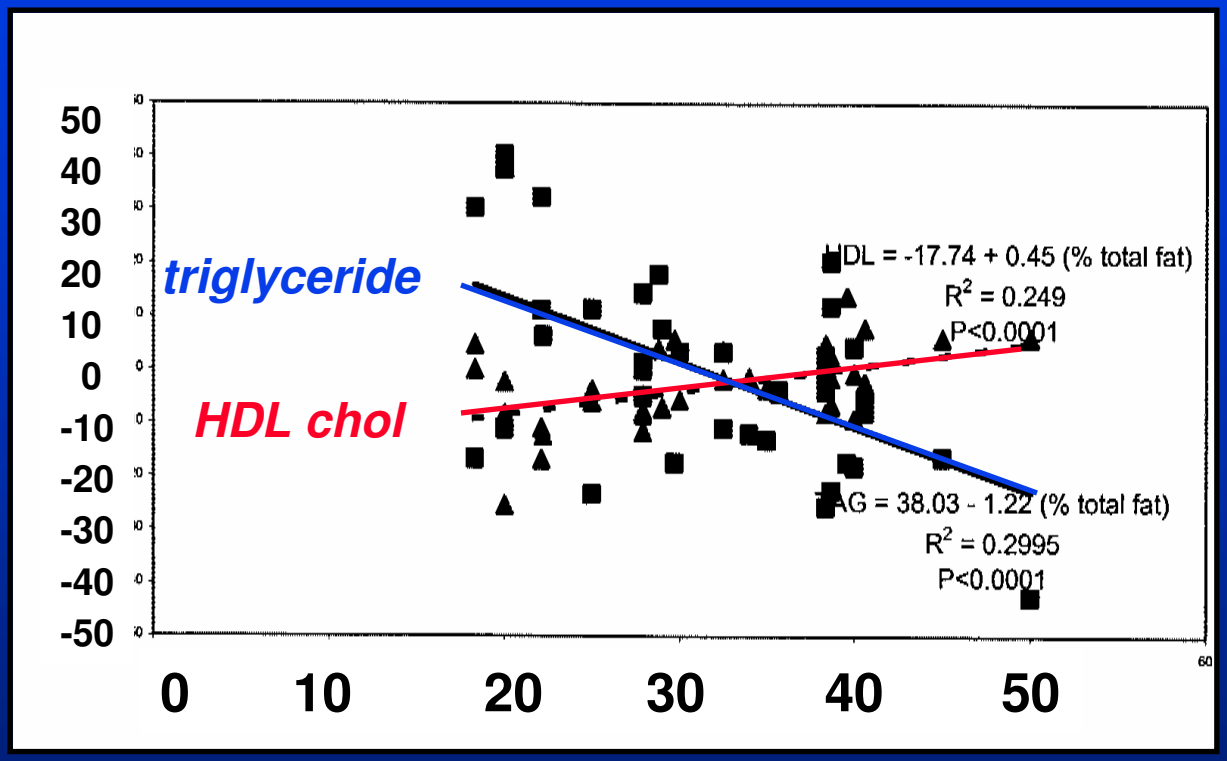
Higher dietary total fat (lower carb) reduces ratio of total cholesterol/HDL cholesterol



Institute of Medicine DRI Panel on Macronutrients, 2002

Higher dietary total fat (lower carbohydrate) lowers blood triglyceride and raises HDL



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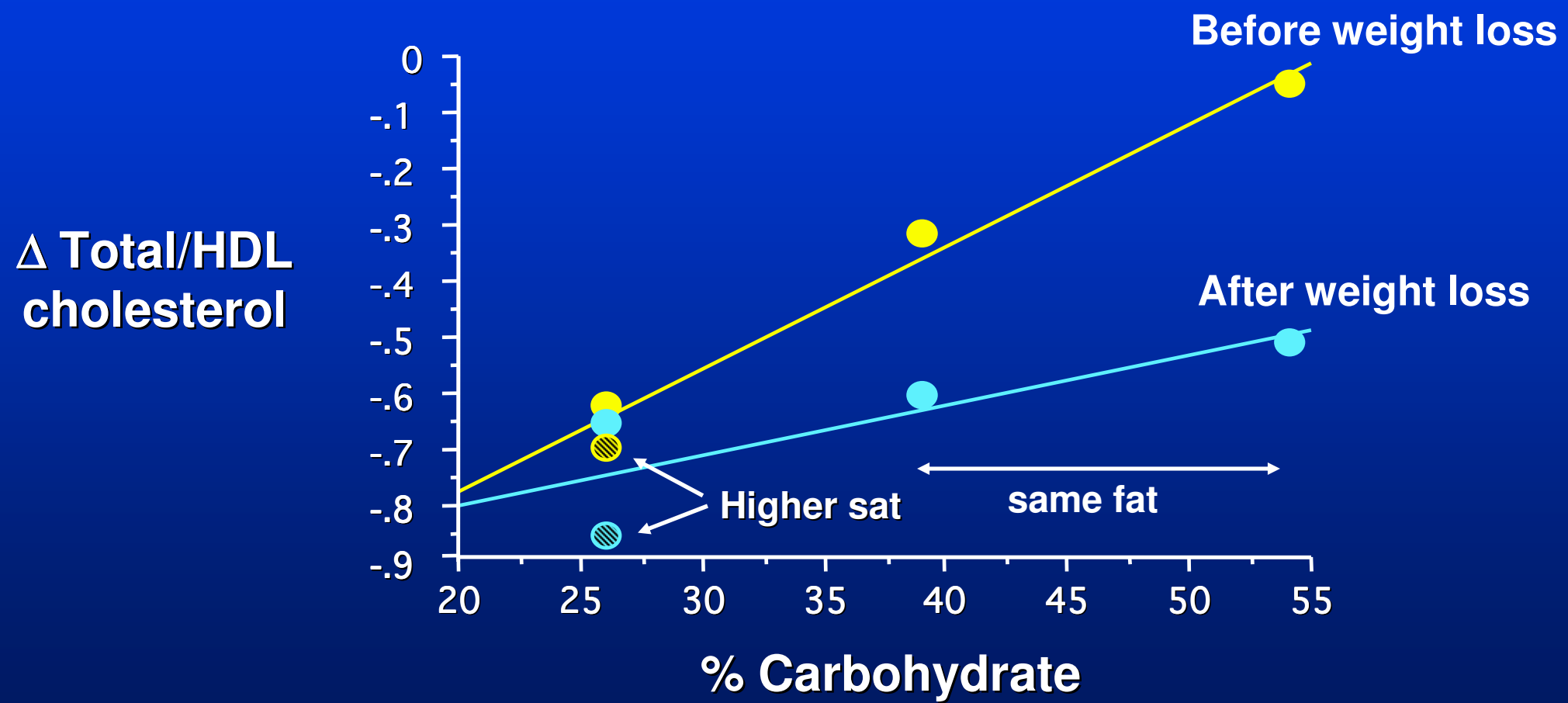
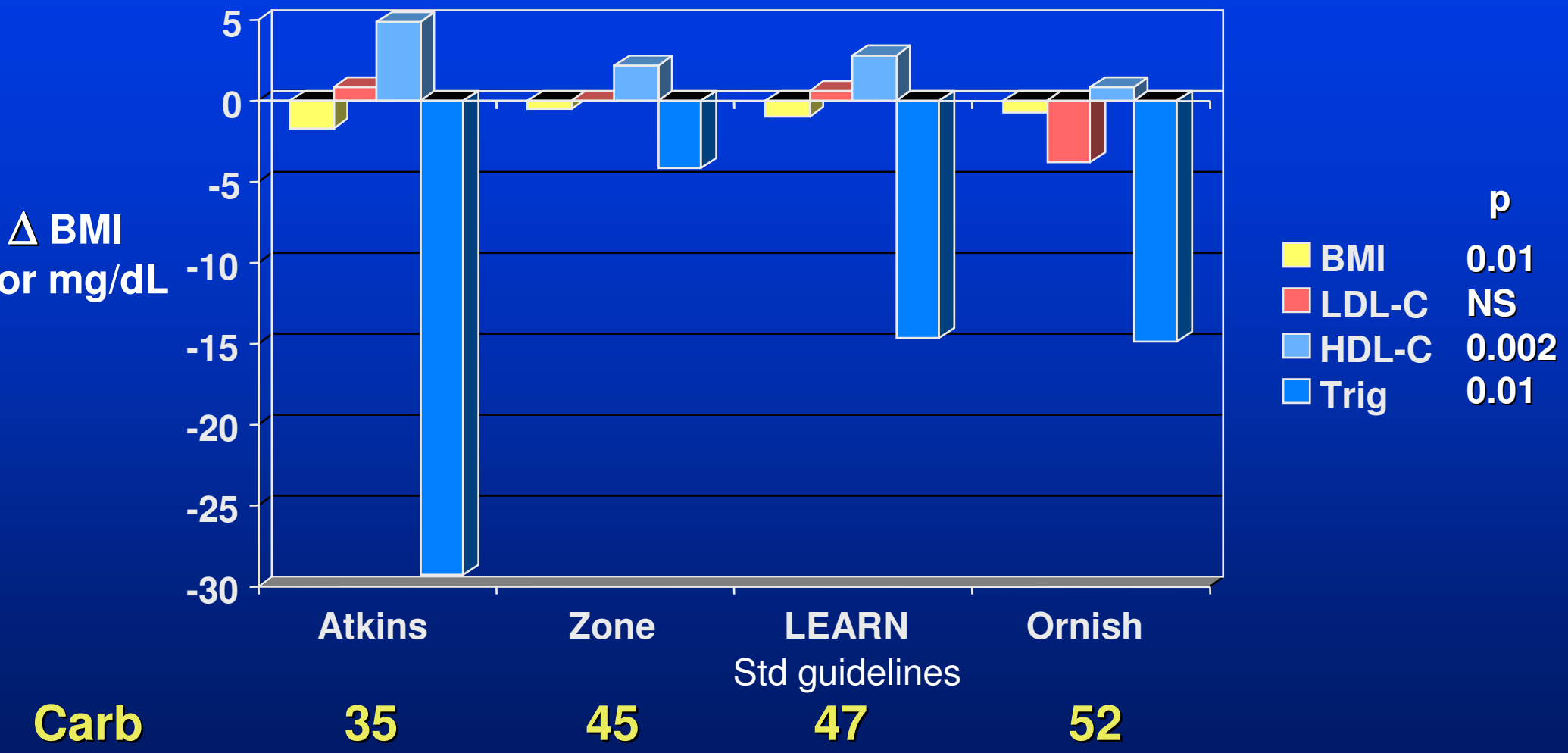
Changes in Total/HDL Cholesterol with Carbohydrate Reduction and Weight Loss



Krauss et al, AJCN 83:1025, 2006

What are weight and metabolic effects of moderating carbohydrate intake in longer term trials?

Weight loss and lipid effects of 4 diets at 12 mos



Gardner et al., JAMA 297:969, 2007

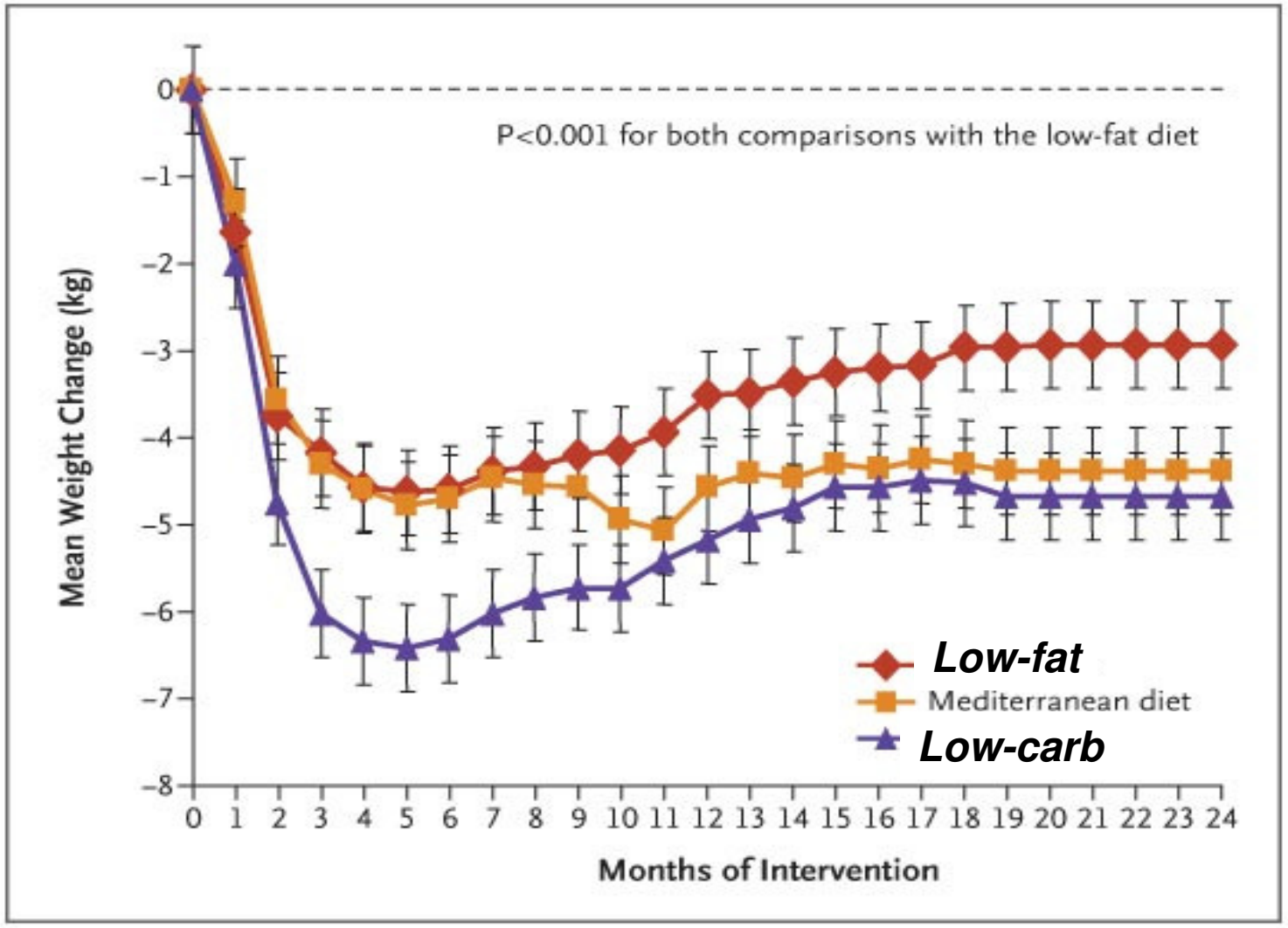
Comparison of three diets over two years in 322 obese individuals

- Low-fat, calorie restricted: 51% carb, 31% fat
- "Mediterranean", calorie restricted: 50% carb, 33% fat
- Moderate carb, no calorie restriction: 40% carb, 39% fat

- Calorie reduction similar on all diets (~370 to 570 per day)
- Saturated fat: 12.3% on lo-carb, 9.6% on others
- Dietary fiber: ↓10 g/d in low-carb; less change in others
- Maximum weight loss in 1st six months, maintenance after

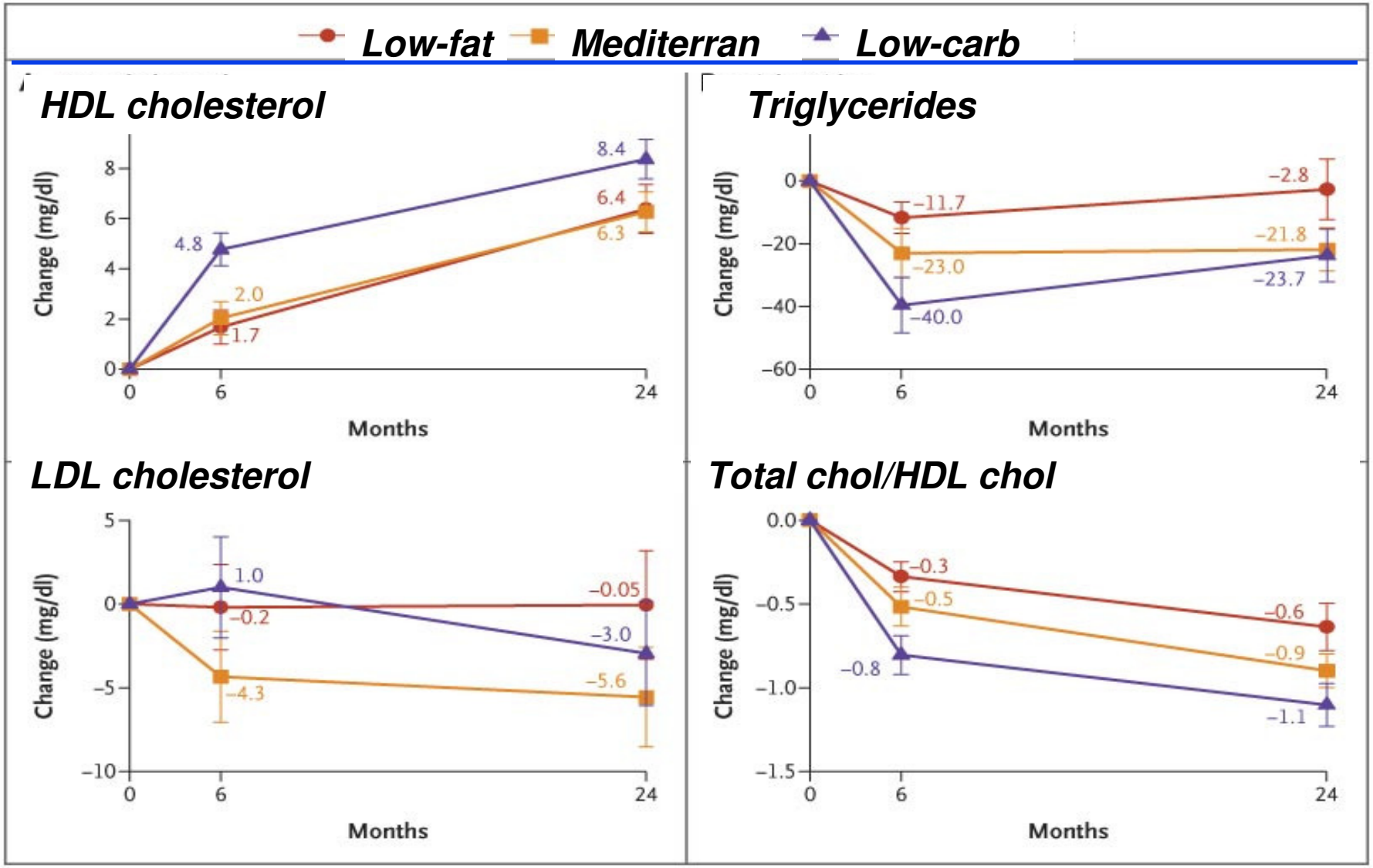
Shai I et al. N Engl J Med 359:, 2008

Weight Changes During 2 Years



Shai I et al. N Engl J Med 359:229, 2008

Changes in Lipids



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Relation of tissue fat to insulin resistance

- Insulin reduces sugar production by liver and increases sugar uptake in other tissues
- Excess liver, abdominal, and muscle fat can lead to insulin resistance
- Insulin resistance leads to higher sugar production and predisposes to diabetes

Dietary carbohydrate: is fructose a particular culprit for making fat?

- A recent discovery shows that liver fat synthesis and blood triglyceride and cholesterol levels are strongly controlled by a genetic pathway activated by fructose

Lee et al., Science 320:1492, 2008

Conclusions

- Moderately low carbohydrate intake, with substitution of fat and/or protein, can improve “metabolic fitness”, including weight management, lipid predictors of cardiovascular disease, and risk for type 2 diabetes.

- Effects vary with type of carbohydrate:
  - sugar (fructose) is of special concern
  - foods with high fiber and slowly digested starches have lesser impact and add nutritional value.