

# Preventing Diabetes



## Preventing Diabetes

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*The Prevention Series*

## The Problem

- 18.2 million Americans have diabetes
  - 5.2 million are unaware
  - 13 million are diagnosed and treated
  - Another 41 million people have prediabetes

1.3 million people will be diagnosed with diabetes this year (2,200 every day)

Diabetes is the 6<sup>th</sup> leading cause of death

Diabetes increased by 33% this last decade

Diabetes Fact Sheet, ADA web site, 2005

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Diabetes is the most costly health problem paid for by Medicare



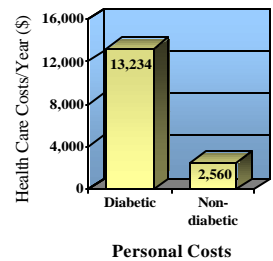
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## Total Annual Costs for Diabetes

- Direct health care costs, \$92 billion/yr
- Lost productivity (lost work days, disability, etc.) \$40 billion/yr
- Total \$132 billion/yr
- Health costs per person
  - \$13,243/diabetic/yr
  - \$2,560/non-diabetic/yr



Diabetes Care, March, 2003

4

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## Complications

### Diabetes ...

- Is the leading cause of blindness in the U.S.
- Is the leading cause of end stage kidney disease
- Is responsible for 60% of nontraumatic lower-limb amputations
- Causes heart disease, the leading cause of death of diabetics
- Causes high blood pressure, 73% of adults with diabetes have high blood pressure
- Increases the risk for stroke by 2-4 times
- Damages nerves in 60-70% of people with diabetes
- Shortens life expectancy by 4-7 years

ADA, Fact Sheet 2002

5

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## What is diabetes?

- Diabetes is a disease that impairs the body's ability to use food (carbohydrate), caused by an insulin defect
  - Pancreas quits making insulin (type 1)
  - Body is resistant to insulin (type 2)
- Without adequate insulin, sugar builds up in the blood, damaging the body's tissues and organs

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## Signs and Symptoms of Diabetes

- Unusual thirst and frequent urination
- Extreme hunger
- Unusual weight loss
- Fatigue, irritability
- Frequent infections including bladder infections
- Blurred vision
- Cuts/bruises that are slow to heal
- Tingling/numbness in hands or feet

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## How High Blood Sugar Levels Harm Health

- Increases the risk of coronary heart disease (CHD)
- Increases the risk of cancer
- Increases the risk of all-cause mortality
- Increases the risk of Alzheimer's Disease



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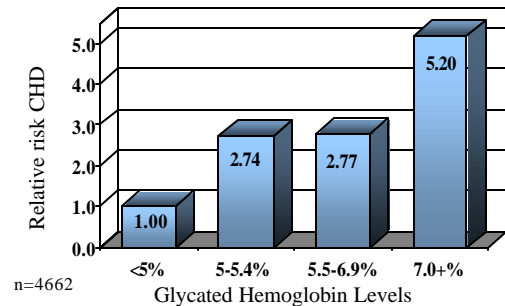
## Glycated Hemoglobin (HbA1c)

- High blood sugar increases the risk of coronary heart disease.
- A Hemoglobin A1c test indicates the average blood glucose concentration over the past three months.
  - This test is a screening tool for metabolic syndrome or diabetes ( a HbA1c of 7.0 or higher may indicate diabetes).
  - It also predicts increased risk of heart disease and overall mortality even for people without diabetes.

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## Glycated Hemoglobin and Coronary Heart Disease

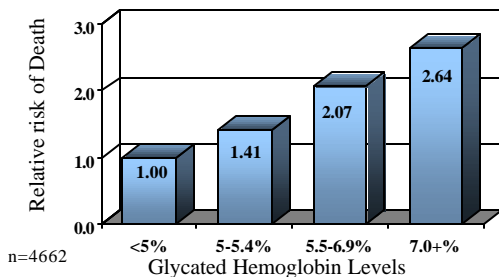


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British Med. Jour., Jan. 6, 2001



## Glycated Hemoglobin and Mortality from All Causes



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British Med. Jour., Jan. 6, 2001



## Study Findings

- An increase of 1% in glycated hemoglobin is associated with roughly a ...
  - 30% increase in mortality from all causes
  - 40% increase in mortality from coronary heart disease

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British Med. Jour., Jan. 6, 2001



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## Conclusions

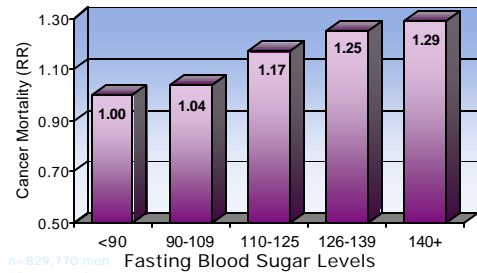
- 80% of excess mortality due to high glycated hemoglobin was in people without diabetes
- Only about 5% of the population over age 45 has diabetes
- But, about 70% of the non-diabetic population over 45 has high glycated hemoglobin levels (HbA1c of 5% or higher)

British Med. Jour., Jan. 6, 2001

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## Fasting Blood Sugar Levels and Cancer Risk

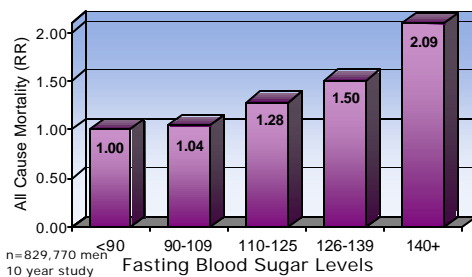


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JAMA, January 12, 2005



## Fasting Blood Sugar Levels and Mortality



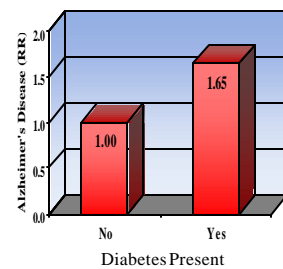
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JAMA, January 12, 2005



## Diabetes and Risk of Alzheimer's

- Study of 824 seniors
- Those with diabetes were 65% more likely to develop Alzheimer's disease after adjusting for age, sex, and education.



Archives of Neurology, May, 2004

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## The Good News is:

Most cases of Type 2 Diabetes can be prevented



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## Improve Insulin Use

- Lose excess weight, even 10-15 pounds helps significantly
- Increase the level of physical activity
  - Goal of 30-45 minutes daily, 150+ min/week
- Choose healthy fats
- Increase dietary fiber intake
- Decrease glycemic load

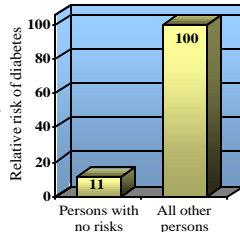
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## Lifestyle and Risk of Diabetes

- 16 year study of 84,941 women
- Studied 4 major risk factors:
  - Overweight
  - Sedentary lifestyle
  - Smoking
  - Poor diet (low fiber, high trans fats, high glycemic index)
- Women with none of these risks:
  - Cut their risk of diabetes by 88% to 91% compared to all other women
  - Those with a family history of diabetes cut their risk by 91%



JAMA, Dec. 1, 1999

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## Researchers' Conclusion

“Our findings support the hypothesis that the majority of cases of type 2 diabetes (90% in this study) could be prevented by the adoption of a healthier lifestyle.”

- Maintain a healthy weight (or even moderate weight loss)
- Eat healthy foods
  - high in fiber
  - low in glycemic index
  - healthy fats (use vegetable oils, avoid trans fats)
- Get regular physical activity
- Avoid smoking



NEJM 345:790-7, 2001

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## Diabetes is a chronic disease

- There is no cure.
- Prevention must be the focus.



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## Intervention Trial to Prevent Diabetes

- Researchers studied 3,234 individuals at high risk for diabetes
  - Overweight
  - Prediabetic
  - Mostly sedentary
- Participants were randomly assigned to one of three groups
  - Placebo
  - Medication (metformin)
  - Lifestyle intervention

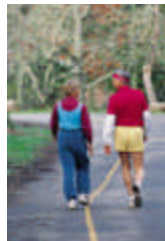
NEJM 346:393-403, Feb. 7, 2002

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## Intervention Trial to Prevent Diabetes

### Lifestyle intervention:

- Weight loss goal
  - 7% of weight
- Exercise goal
  - 150 min of aerobic activity per week (mostly walking)
- Improve eating habits
  - Higher fiber intake (25-38 g)
  - Lower saturated fat (<7% cal)
  - Lower glycemic load



NEJM 346:393-403, Feb. 7, 2002

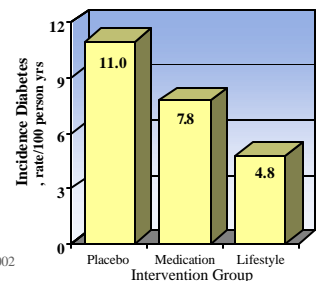
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## Intervention Trial to Prevent Diabetes

### Results

The incidence of diabetes was 58% lower in the lifestyle intervention group, and 31% lower in the metformin group, compared to the placebo group

NEJM 346:393-403, Feb. 7, 2002



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## Risk Factors for Diabetes

- Increasing age, 45+
- Race: African-American, Hispanic, Native Americans, Pacific islander
- Woman with gestational diabetes or baby over 9 lb.
- Overweight
- Smoking
- Poor diet
  - Excess calories
  - High glycemic diet
  - Low dietary fiber
  - High saturated/trans fat, low polyunsaturated fats
- High blood pressure
- High blood fats/low HDL cholesterol
- Elevated blood sugar, 110-125 prediabetes

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## What is your risk of diabetes?

Complete your self-test and find out.



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## The Best Treatment is Always Prevention

- “Diabetes is a chronic disease with no cure. Prevention must be the focus if we hope to reduce the devastating impact of diabetes on the health of our nation.”

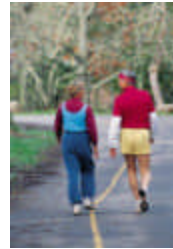
American Diabetes Association Fact Sheet.

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## Prevention Steps

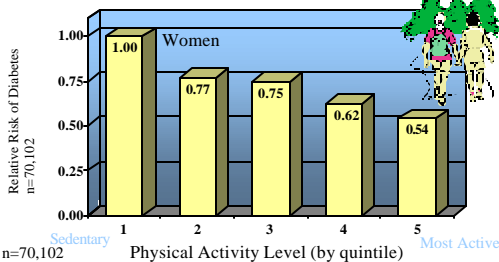
- Be physically active
- Choose healthy meals
- Achieve and maintain a healthy weight
- Avoid smoking



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## Physical Activity and Risk of Diabetes



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## Diabetes Walking Study



- Walked 2 hrs/week
  - 39% decrease in mortality from any cause
  - 34% decrease in cardiovascular mortality
- Walked 3-4 hours/week
  - 54% decrease in deaths from any cause
  - 53% decrease in cardiovascular deaths
- Reported any brisk walking
  - 43% decrease in overall mortality

Archives of Internal Medicine 163:1440-47, Jun 23, 2003

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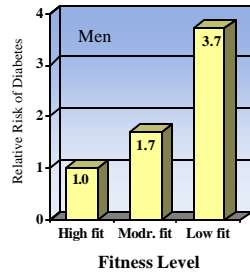


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## Fitness and Diabetes Risk

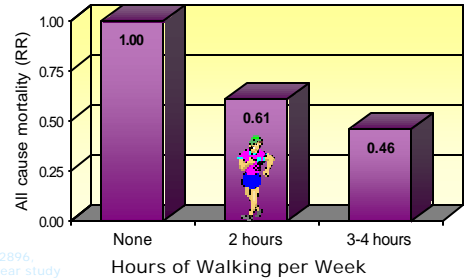


- 8,633 men free of diabetes studied for 6 years
- Highly fit men were protected against getting diabetes
  - Low fit men were 3.7 times more likely to get diabetes than highly fit men
  - Moderately fit men were 1.7 times more likely to get diabetes than highly fit men



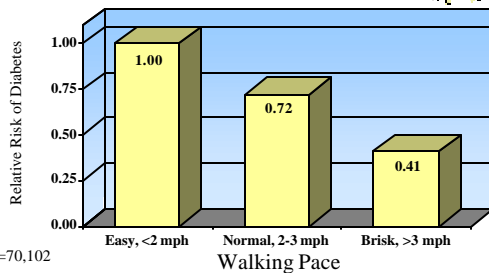
31 © 2004 - 2006 Wellsource, Inc. All rights reserved. Ann Intern Med 1999 Jan 19;130(2):89-96

## Walking Reduces Mortality in Diabetics



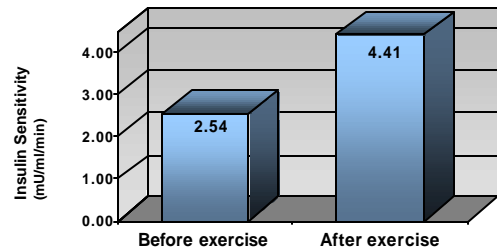
32 n=2896, 8 year study Archives of Internal Medicine 163:1440-47, Jun 23, 2003 © 2004 - 2006 Wellsource, Inc. All rights reserved.

## Walking Pace and Risk of Diabetes



33 n=70,102 Nurses' Health Study, JAMA, Oct. 20, 1999 © 2004 - 2006 Wellsource, Inc. All rights reserved.

## Exercise Improves Insulin Sensitivity



34 18 subjects, 6 month trial, exercised 30 min, 3-7 days/wk, no change in weight Diabetes Care 26:557-562, Mar 2003 © 2004 - 2006 Wellsource, Inc. All rights reserved.

## Exercise and Weight Loss Improve Insulin Sensitivity

- Regular activity...
  - Improves insulin sensitivity in the liver and peripherally
  - Lowers blood glucose levels
  - Lowers glycated hemoglobin levels
  - Lowers blood pressure
  - Lowers blood fats, raises HDL levels
- Lowers the demand on the pancreas and helps prevent or control diabetes and its problems



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## Case Study

- Leland developed diabetes at 38
- Weighed 200 pounds – doctor started him on medication
- Leland began regular exercise
  - He walked until his weight was down, then 3 months of walking + intervals before he could run 1 mile
- Lost 25+ pounds
  - After several years he:
    - Runs 5 miles 3x/wk, more on weekend – has run 6 marathons
    - Loves mountain trail hiking
- With lifestyle changes he was able to stop his medication for 10 years



Leland

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## Choose Healthy Meals

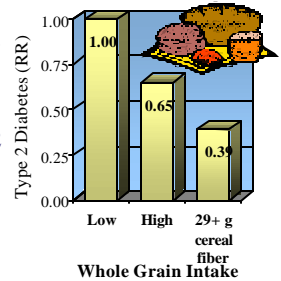
- High dietary fiber intake
- Moderate carbohydrate intake
- Low glycemic load



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## Whole Grains and Risk of Diabetes

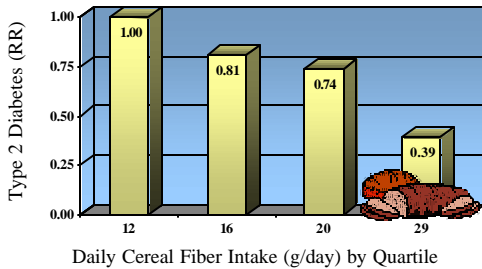
- Finnish study, 4300+ men/women, 10 yr study
- Those eating the most whole-grains had 35% less type 2 diabetes
- Those with highest cereal fiber intake had 61% less diabetes



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Amer J Clin Nutrition, March 2003

## Cereal Fiber and Type 2 Diabetes



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Amer J Clin Nutrition, March 2003

## Whole Grains and Type 2 Diabetes

### In summary:

“We found a reduced risk of type 2 diabetes in persons with high whole-grain intake. This reduced risk was apparently due to cereal fiber intake.”

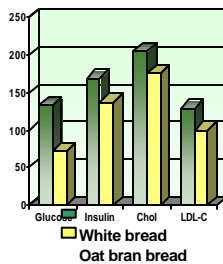


Amer J Clin Nutrition, March 2003

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## Oat Bran Lowers Blood Sugar Levels

- Total glucose response dropped 46%
- Insulin response dropped 19%
- Total cholesterol levels dropped 14%
- LDL cholesterol levels dropped 23%
- HDL levels increased 8%



Ref: JADA, Dec. 1996

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## Understanding Carbohydrate

- Early research showed that blood glucose levels were similar if people were fed equal amounts of energy from:
  - Table sugar
  - Wheat starch or white bread, or
  - Potato
- The concept of rating carbohydrates as simple sugars or complex carbohydrates was of no value
- Thus, they needed a new way of rating the effect of carbohydrate on blood sugar levels and health

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## Concept of Glycemic Index

- Glycemic index is a way of evaluating the effect of carbohydrate on blood sugar levels
- It is defined as the area under the glucose response curve after eating a standard amount of carbohydrate relative to a control food such as glucose or white bread.

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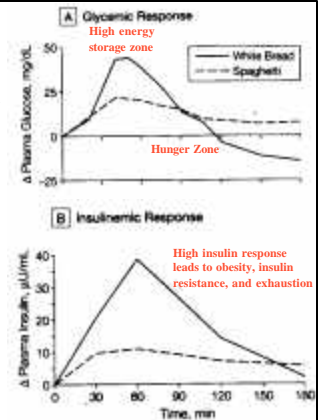
Blood glucose and insulin curves after eating:

White bread (solid line)

and then

Spaghetti (dotted line)

Food eaten on different days



JAMA May 8, 2002, 287:2415

## High Glycemic Meals

- Eating high glycemic meals, compared to lower glycemic meals, results in:
  - Higher 24 hour blood sugar levels
  - Higher insulin levels
  - Higher glycosylated hemoglobin levels (HbA1c)
  - Increased hunger following reactive low blood sugar
- It also results in increased risk for diabetes, obesity, and coronary heart disease

JAMA May 8, 2002, 287:2415

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## Glycemic Index and Obesity

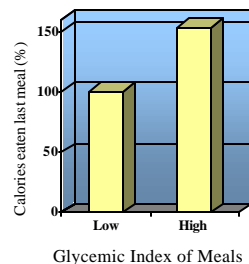
- Rats fed a high glycemic diet compared to rats fed a low glycemic diet develop marked obesity in 32 weeks.
- In 16 human studies, 15 studies found lower satiety, increased hunger, and higher voluntary food intake after eating high vs. low glycemic index meals.

JAMA May 8, 2002, 287:2415

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## Glycemic Index and Calorie Intake in Children

- Obese children ate instant oatmeal (high glycemic index) or steel-cut oats (lower glycemic index) with identical calories for breakfast and lunch.
- They ate what they wanted for supper.
- After eating the high-glycemic index meals, they ate 53% more calories than after they ate the low-glycemic index meals.

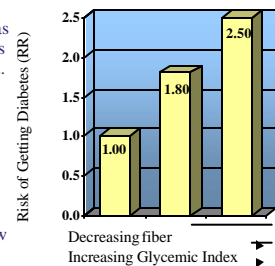


JAMA May 8, 2002, 287:2415

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## Glycemic Index, Dietary Fiber and Risk of Diabetes

- Women's Health study
- Women who ate the least fiber were twice as likely to get diabetes as those who ate the most.
- Women with the highest glycemic index were 51% more likely to get diabetes than women who ate the lowest GI diet.
- Overall risk was 2.5 times higher on the low fiber, high GI diet.

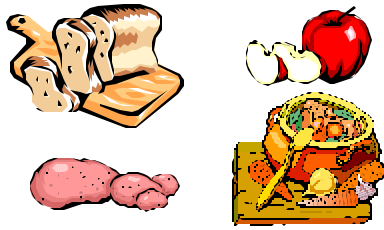


JAMA Feb. 12, '97

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## Glycemic Index of Some Common Foods



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## Grains – Glycemic Index

Food	G.I.	Food	G.I.
French bread	136	Pastry	84
White rice	126	Rice (Basmati) white	83
Corn chips	125	Pita bread	82
English muffin	110	Brown rice	79
Doughnut	108	Oatmeal cookie	79
Waffle	109	Sweet corn	78
Bread, White	100	Pound cake	77
Whole wheat bread	98	WW bread, stone ground	76
Taco shells	97	Bulgur	69
Rye bread	92	Oat bran bread	68
		Pasta	64

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## Cereals – Glycemic Index

Food	G.I.	Food	G.I.
Barley, pearled, ckd	36	Corn meal	98
All-bran	60	Shredded wheat	99
Oatmeal, old-fashioned	70	Cream of wheat	100
Whole wheat, quick	77	Millet	101
Kellogg's mini-wheats	81	Cheerios	106
Bran chex	83	Corn chex	118
Wheat kernels, whole	84	Corn flakes	119
LIFE cereal	94	Rice chex	127
Grape-nuts	96		

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## Fruits – Glycemic Index

Food	G.I.	Food	G.I.
Cherries	32	Grapes	66
Grapefruit	36	Orange juice	74
Apricots, dried	44	Banana	77
Pear	53	Apricots	81
Apple	54	Raisins	91
Apple juice	57	Apricots, canned syrup	91
Peach	60	Pineapple	94
Orange	63	Watermelon	103

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## Legumes/Vegetables Glycemic Index

Legumes	G.I.	Vegetables	G.I.
Soy beans	26	Parsnips	139
Soy milk	44	Potato baked	121
Lentils	41	French fries	107
Kidney beans	42	Pumpkin	107
Butter beans	44	Potato steamed	93
Split peas	45	Beets	91
Pinto beans	55	Sweet corn	78
Chick peas	60	Sweet potato	77
Peanuts	21	Carrot	70
		Green peas	68
		Broccoli, greens, cabbage ~20 cauliflower, s. squash	

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## Sugars – Glycemic Index

Sugars	G.I.	Misc. foods	G.I.
Fructose	32	Milk, full fat	39
Lactose	65	Milk, skim	46
Honey	83	Chocolate milk	49
High fructose corn syrup	89	Yogurt, sweetened	51
Sucrose - table sugar	92	Ice cream, full fat	87
Glucose	137	Soft drink	97
Maltose	150	Coca Cola	90
		Pizza	60
		Tomato soup	54
		Soda crackers	106
		Dates, dried	146
		Tofu frozen dessert	164

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## Glycemic Load Concept

- Glycemic load is the glycemic index of a food times the carbohydrate in that food stated as grams.
- A glycemic load less than 150/day is desirable (low risk).

Glycemic index of a carrot = 70  
 One carrot, 7.5 inches, has 7.3 g CHO  
 Glycemic Load:  
 (GL) =  $7.3 \times 70 / 100 = 5.1$

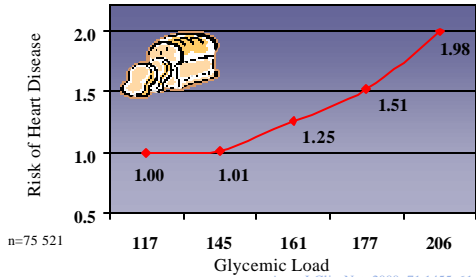


Glycemic index of a potato = 121  
 One baked potato has 51 g CHO  
 Glycemic Load:  
 (GL) =  $51 \times 121 / 100 = 61.7$   
 - 8 times the glycemic load of a carrot!

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## Glycemic Load and Risk of Heart Disease



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## Glycemic Load of Common Foods

Food	Glycemic Load	Food	Glycemic Load
Instant rice, 1/2 C	25	Banana, 1	13
Baked potato, sm.	20	Spaghetti, 1/2 cup	16
Corn flakes, 2/3 C	21	Apple, 1 fresh	8
Carrot, 1	5	Lentils, 1/2 C	6
White bread, 2 slices	21	Peanuts, 1 oz.	3
Rye bread, 2 slices	19	Broccoli, 1/2 C	< 1
Muesli, 2/3 C	17		

JAMA May 8, 2002, 287:2415

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## Glycemic Principle

### High Glycemic Foods

- Snack foods
- Fast foods
- Pastry, cookies
- Sweets
- Soda pop
- White bread/rice
- Refined carbohydrates
- Potatoes

### Low Glycemic Foods

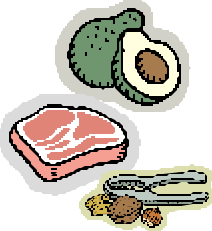
- Fresh fruits
- Vegetables
- Legumes, peas, beans, garbanzos, soy, tofu
- Nuts
- Whole-grain breads and cereals, oatmeal, and brown rice
- Protein rich foods
- Healthy fats

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## Other Dietary Factors and Diabetes Prevention

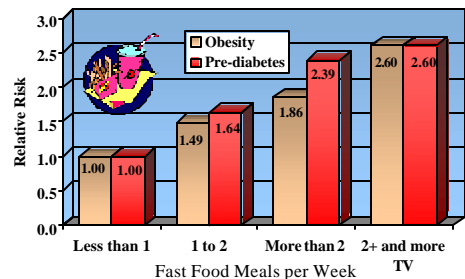
- Breakfast and diabetes risk
- Kinds of fat and risks
- Nuts and diabetes risk
- Milk and insulin resistance



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## Fast Foods, Obesity, and Diabetes



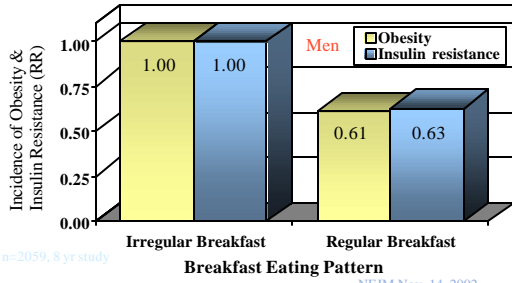
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Circulation, Feb. 25, 2003



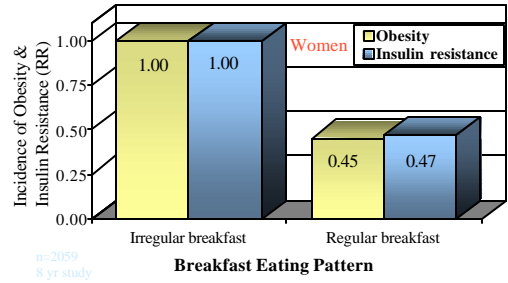
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## Breakfast, Obesity, and Insulin Resistance



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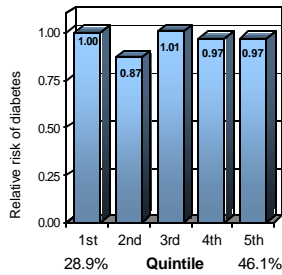
## Breakfast, Obesity, and Insulin Resistance



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## Total Fat Intake and Risk of Diabetes

- Nurse's Health Study
  - 84,204 women
  - 14 year study
- Total fat intake was not associated with risk of diabetes
- Neither was animal fat intake

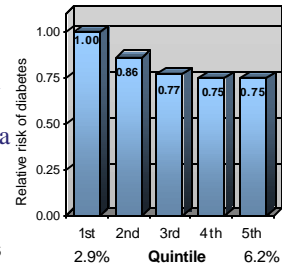


Amer J Clin Nutr., 2001, 73:1019-26

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## Polyunsaturated Fat and Risk of Diabetes

- Nurse's Health Study
  - 84,204 women
  - 14 year study
- Polyunsaturated fat was associated with a lower risk of getting diabetes (by 25%, p=0.0002)

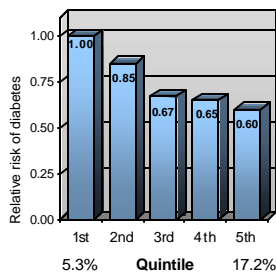


Amer J Clin Nutr., 2001, 73:1019-26

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## Vegetable Fat and Risk of Diabetes

- Nurse's Health Study
  - 84,204 women
  - 14 year study
- Vegetable fat reduced risk of getting diabetes (by 40%, p=0.0001)

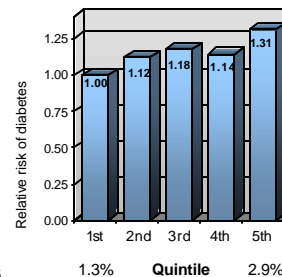


Amer J Clin Nutr., 2001, 73:1019-26

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## Trans Fatty Acids and Risk of Diabetes

- Nurse's Health Study
  - 84,204 women
  - 14 year study
- Trans fatty acid intake was linked to a higher risk getting diabetes (by 31%, p=0.02)



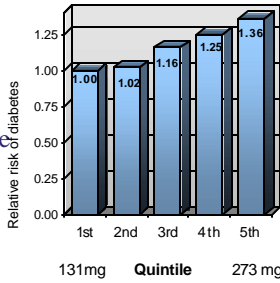
Amer J Clin Nutr., 2001, 73:1019-26

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# Preventing Diabetes

## Dietary Cholesterol and Risk of Diabetes

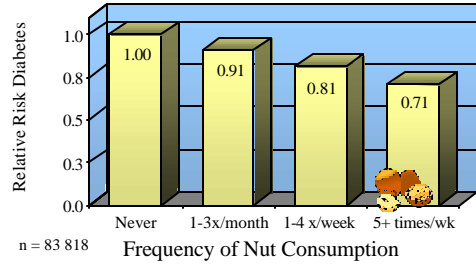
- Nurse's Health Study
  - 84,204 women
  - 14 year study
- Dietary cholesterol intake was linked to a higher risk of getting diabetes (by 36%,  $p=0.0001$ )



Amer J Clin Nutr., 2001, 73:1019-26

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## Nut Consumption and Risk of Type 2 Diabetes

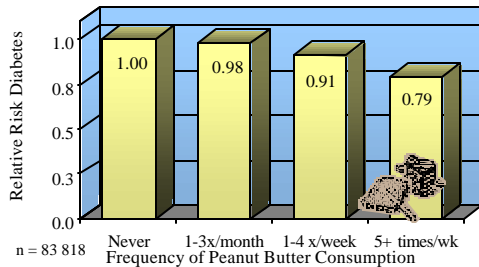


n = 83 818

JAMA 288:2554-60, Nov 27, 2002

68

## Peanut Butter Consumption and Risk of Type 2 Diabetes



n = 83 818

JAMA 288:2554-60, Nov 27, 2002

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## Protective Benefits of Nuts

- Nuts are rich in unsaturated fats
  - Vegetable fats (oils) protect against diabetes
  - Saturated and trans fats increase risk
- Nuts are rich in fiber and magnesium
  - Fiber is protective against diabetes
  - Adequate magnesium helps improve insulin sensitivity
- Nuts have a low glycemic index
- Nuts are good sources of vitamins, minerals, antioxidants, and plant proteins that may also be protective

JAMA 288:2554-60, Nov 27, 2002

70

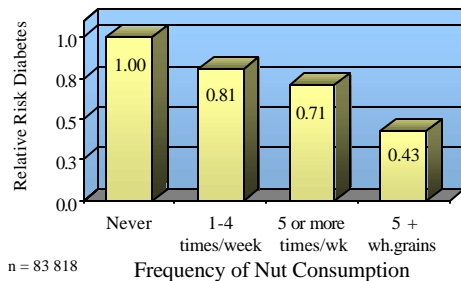
## Nuts and Weight Gain

- Researchers looked at the frequency of nut consumption and weight gain during a 16 years study
  - There was essentially no difference in weight gain in those who ate the least to the most nuts
  - Those women who ate the most nuts tended to weigh less than those who seldom ate nuts
- To avoid increasing caloric intake, eat more nuts in place of:
  - Refined grain products (chips and snacks)
  - Red and processed meats

JAMA 288:2554-60, Nov 27, 2002

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## Nuts Plus Whole Grains and Diabetes Risk



n = 83 818

JAMA 288:2554-60, Nov 27, 2002

72

# Preventing Diabetes

## Diet and Insulin Resistance

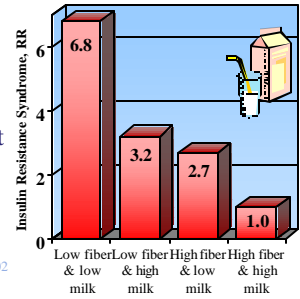
- Researchers studied the health practices and eating habits of 3157 young adults over a 10 year period.
- They looked for factors linked to insulin resistance.



JAMA 287:2081-89, Apr 24, 2002

## Milk, Fiber, and Insulin Resistance

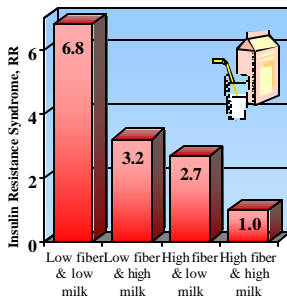
- Researchers found that dietary fiber and milk products protect against insulin resistance.



JAMA 287:2081-89, Apr 24, 2002

## Milk, Fiber, and Insulin Resistance

- A low fiber intake and a low intake of milk increased insulin resistance by 7 times compared to a high intake of fiber and milk.



JAMA 287:2081-89, Apr 24, 2002

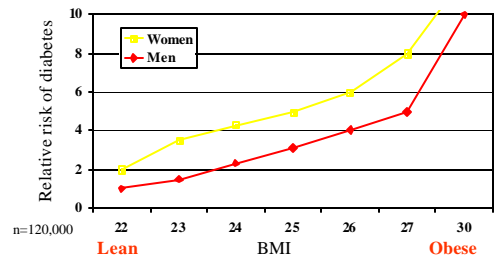


MyPyramid

Excess fat is the single largest cause for diabetes



## BMI and Risk of Diabetes



n=120,000  
Lean BMI Obese

NEJM, Aug 5, '99, 430

# Preventing Diabetes

## Weight Ranges Based on BMI

Ht(in)	BMI 20	BMI 25*	BMI 30**
58 in.	96 lb	119 lb	143 lb
60	102	128	153
62	109	136	164
64	116	145	174
66	124	155	186
68	131	164	197
70	139	174	209
72	147	184	221
74	155	194	233
76	164	205	246

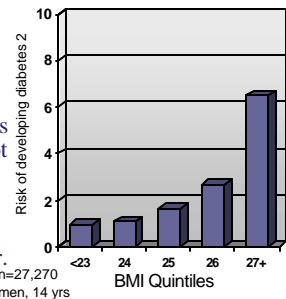


\* People with a BMI less than 25 live the longest  
 \*\* Obesity is defined as a BMI of 30+

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## BMI and Risk of Diabetes 2

- Risk for diabetes 2 increases directly with an increase in BMI.
- BMI also predicts diabetes 2 but not as well as waist girth.
- Waist girth was the best predictor.

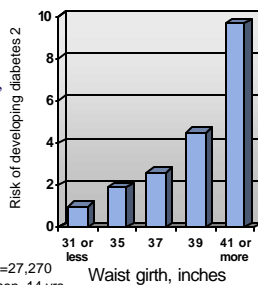


Am J Clin Nutr 2005;81:555-63 n=27,270 men, 14 yrs

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## Waist Girth and Risk of Diabetes 2

- Risk for diabetes 2 increases directly with waist girth: the larger the waist, the higher the risk.
- 80% of men who developed diabetes 2 had a waist girth greater than 37 inches.



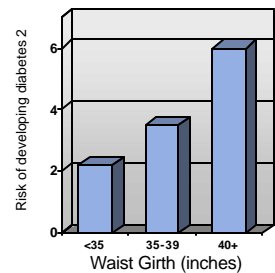
Am J Clin Nutr 2005;81:555-63

n=27,270 men, 14 yrs

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## Waist Girth and Risk of Diabetes 2 in "Overweight" Men (BMI 25-29.9)

- In men in the "Overweight" range, waist girth more accurately determines risk.
- If BMI is elevated but waist girth isn't, your risk may be significantly lower.

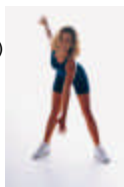


Am J Clin Nutr 2005;81:555-63

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## Summary for Diabetes Prevention

- Adjust calories and activity level to achieve and maintain a healthy weight
- Choose healthy fats:
  - Choose vegetable oils, rich in polyunsaturated fatty acids (at least 6% of calories)
  - Avoid foods with trans fatty acids (partially hydrogenated vegetable oils)
  - Avoid or limit foods with cholesterol
- Choose high fiber foods
- Reduce glycemic load of meals
- Be physically active daily



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## Prevention Goals for Those With Diabetes

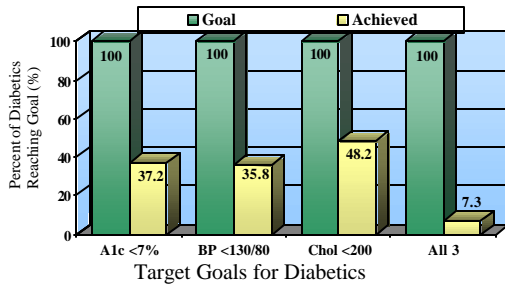
- Blood pressure below 130/80
- LDL cholesterol below 100 mg/dL (2.6 mmol/L)
- Triglycerides below 150 mg/dL (1.7 mmol/L)
- HDL cholesterol above 40 mg/dL (1.1 mmol/L)
- A1c below 7%
- Get regular, aerobic exercise, 30-60 min daily

Guidelines of the American Diabetes Association, NEJM, Jan 30, 2003

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# Preventing Diabetes

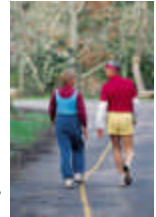
## Poor Control of Risk Factors in Diabetics



85 © 2004 - 2006 Wellsource, Inc. All rights reserved. JAMA 291:335-342, January 21, 2004

## Be Smart About Your Heart Control the ABCs of Diabetes

- **A**1C below 7.0%
- **B**lood pressure below 130/80
- **C**holesterol (LDL) below 100 mg/dL
- **D**aily physical activity, 30+ minutes



ABCs of Diabetes Campaign, National Diabetes Education Program

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# END

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