


## Epidemiological Evidence of an Epidemic: Diabetic Retinopathy

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Associate Professor



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## Competing interests

- None

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## Change in life is certain

- Diets have
  - Conveni
  - One the
  - Glucose



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**Definition**

- A state of absolute or relative insulin deficiency, characterized by hyperglycemia and the risk of microvascular and macrovascular complications

*World Health Organization*

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**Diabetes**

- Diabetes is usually considered a disease of developed society
- With type -2 diabetes most common
  - Usually affecting middle aged population
- Diagnostic criteria- type -2
  - Fasting plasma glucose  $\geq 126$ mg/dL
  - Random plasma glucose  $\geq 200$  mg /dL

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Epidemiology/Health Services/Psychosocial Research

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**Global Burden of Diabetes, 1995-2025**  
Prevalence, numerical estimates, and projections

*Diabetes Care 21:1414-1431, 1998*

HILARY KING, MD, DSC  
RONALD E. ALBERT, PHD  
WILLIAM H. HERMAN, MD, MPH

- World wide 300 million are expected to have diabetes by 2025....Mathematical projections

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## Where are we now?

- August 2011 –
- 346 million people worldwide have diabetes. \*
- Type -2 still the most common
  - However people affected are younger and younger

\*<http://www.who.int/mediacentre/factsheets/fs312/en/>

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## Diabetes worldwide

- It is estimated that more than one third of diabetic population worldwide will be from Asia (121.8 million).
- Top 5 countries worldwide in diabetes
  1. India
  2. China
  3. USA
  4. Russia
  5. Japan

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## USA trends

1990

1998



5 states had DM >6%

22 states have DM >6%

Diabetes Care 23:1278-1283, 2000

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Epidemiology/Health Services/Psychosocial Research  
ORIGINAL ARTICLE

### Diabetes Trends in the U.S.: 1990-1998

- 33% increase in DM 1990 to 1998
- All ages
- Both sexes were affected
- All education levels

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### Prevalence highly correlates with obesity

	1990	1998
Diabetes (%)		
Total	4.9 (0.12)	6.5 (0.11)
Men	4.1 (0.16)	5.5 (0.15)
Women	5.6 (0.17)	7.4 (0.16)
Weight (kg)		
Total	72.6 (0.09)	76.2 (0.08)
Men	81.0 (0.12)	84.3 (0.11)
Women	64.6 (0.10)	68.5 (0.10)

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### Where are we now USA?

## National Diabetes Statistics, 2011



<http://www.diabetes.niddk.nih.gov/>

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### Prevalence in USA

Diabetes affects 25.8 million people of all ages  
8.3 percent of the U.S. population

DIAGNOSED 18.8 million people

UNDIAGNOSED 7.0 million people

Age Group	Percent
20-44	3.7%
45-64	13.7%
≥65	26.9%

<http://www.diabetes.niddk.nih.gov/>

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### Prevalence cont...

- 215,000 <20 years of age
- 7.1 % Non-Hispanic White
- 8.4% Asian Americans
- 11.8% Hispanic /Latinos
- 12.6% Non-Hispanic Black

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### Incidence

- 1.9 million diagnosed with diabetes in 2010 ages 20 and older

Age Group	Number
20-44	465,000
45-64	1,052,000
≥65	390,000

<http://www.diabetes.niddk.nih.gov/>

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### Obesity and Body Mass Index

- Definitions:
- Obesity: Body Mass Index (BMI) of 30 or higher.
- Body Mass Index (BMI): A measure of an adult's weight in relation to his or her height,

$$BMI = \frac{\text{mass(kg)}}{(\text{height(m)})^2}$$


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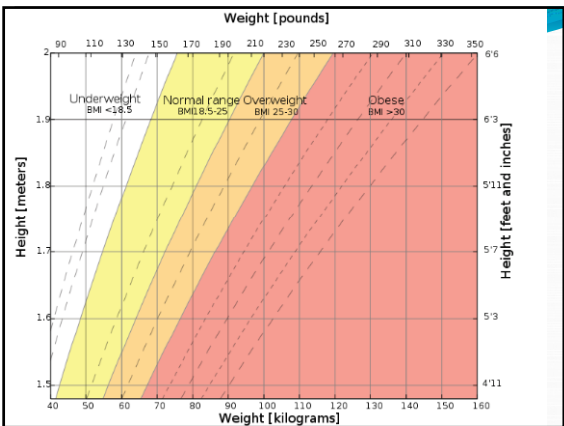
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NCHS Data Brief ■ No. 82 ■ January 2012

### Prevalence of Obesity in the United States, 2009–2010

Cynthia L. Ogden, Ph.D.; Margaret D. Carroll, M.S.P.H.; Brian K. Kit, M.D., M.P.H.;  
and Katherine M. Flegal, Ph.D.

- More than 35% of Americans are obese
- 16.9% of children and adolescents in USA are obese

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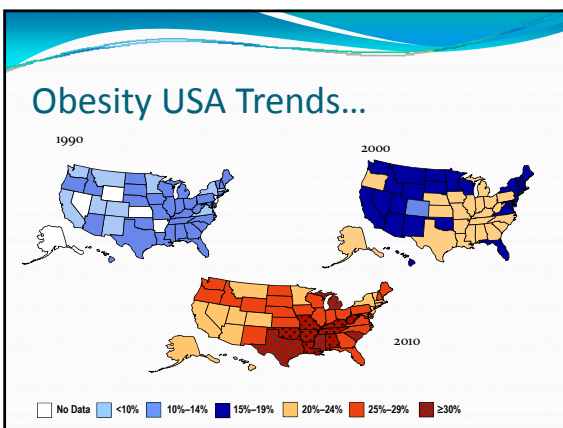
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### Pre-Diabetes

- Fasting glucose
  - 100–125mg/dL
- 2h glucose in glucose tolerance test
  - 140–199 mg/dL
- 79 million Americans greater than 20 years of age will be classified as pre-diabetic

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### Risk factors

<b>Uncontrollable</b>	<b>Modifiable</b>
<ul style="list-style-type: none"><li>• Age</li><li>• Family history</li><li>• Ethnic group</li></ul>	<ul style="list-style-type: none"><li>• Overweight/obesity<ul style="list-style-type: none"><li>• Central/abdominal obesity</li></ul></li><li>• Dyslipidemia</li><li>• Physical inactivity</li><li>• High blood pressure</li></ul>

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### Diabetes Prevention Program

<ul style="list-style-type: none"><li>• 3 groups of pre diabetics<ul style="list-style-type: none"><li>• Fasting glucose</li><li>• 100-125mg/dL</li></ul></li><li>• 2h glucose in glucose tolerance test</li><li>• 140-199 mg/dL</li></ul>	<ul style="list-style-type: none"><li>• Placebo</li><li>• Metformin 850mg B.I.D.</li><li>• Diet and exercise (lifestyle change only)</li></ul>
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### Outcome

- Reduction in progression to type -2 diabetic from pre-diabetic status.

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### Diabetes Prevention Program

- 3 groups
- Placebo
- Metformin 850mg B.I.D.
- Diet and exercise (lifestyle change only)

Group	Percentage Discontinued Study Early
Diet + Exercise	14%
Metformin	22%
Placebo	29%

14% reduction in body weight occurred in 6 weeks

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### Diabetic retinopathy

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### Prevalence

- Examined by various studies
  - Wisconsin epidemiologic study
  - Framingham Eye Study
  - Population based study in Rochester, Minnesota
  - San Luis Valley Study
  - LALES

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### Prevalence

- Although the outcomes vary depending on the study
- Overall
  - 4.2 million patients with diabetes over 40 years of age have diabetic retinopathy
  - 655,000 advanced retinopathy (sight threatening)

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### Incidence

- Fewer studies always harder to ascertain
  - chronic diseases
  - For asymptomatic or mildly symptomatic diseases
- Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR)
- United Kingdom Prospective Diabetes Study (UKPDS)
- The Liverpool Diabetic Eye Study
- Diabetes Control and Complications Trial (DCCT)

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### Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR)

<ul style="list-style-type: none"><li>• 10-year incidence of retinopathy was<ul style="list-style-type: none"><li>• 76% (age &lt;30 yrs)</li></ul></li><li>• 69% (age &gt;30 years on insulin)</li><li>• 53% (non-insulin treated age &gt;30 group)</li></ul>	<ul style="list-style-type: none"><li>• 10 year incidence of macular edema<ul style="list-style-type: none"><li>• 20 % (age &lt;30 years)</li></ul></li><li>• 25% (age &gt;30 years on insulin)</li><li>• 14% (non-insulin treated age &gt;30 group)</li></ul>
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**Progression to proliferative diabetic retinopathy**

- 10 year incidence
  - 30% (age <30 yrs)
  - 24% (age >30 years on insulin)
  - 10% (non-insulin treated age >30 group)

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**United Kingdom Prospective Diabetes Study (UKPDS)**  
Level of glycemia on complications of diabetes type II

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**United Kingdom Prospective Diabetes Study (UKPDS)**

- Randomized trial
- Sample size 3867
- Treatment intensive therapy achieving fasting plasma glucose of 6.0 mmol/L
- Control group conventional therapy
- 12 years follow-up

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### UKPDS

- Intensive therapy reduced the risk of retinopathy progression by 21%
- Reduction in need for laser photocoagulation by 29%

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### Diabetes Control and Complications Trial (DCCT)

- Type I DM
- Age 13 to 39 years
- Sample size 1441
- Treatment group intensive therapy
  - 3 or more times insulin
- Control group
  - 1-2 times insulin
- Mean follow up 6.5 years

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### DCCT cont...2

- Intensive therapy
  1. Reduced incidence of retinopathy by 79%
  2. Progression from early to advanced retinopathy by 54%

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### DCCT cont...3

1. Hba1c to be around 8% lowers risk of retinopathy
2. Intensive treatment best if started early before onset of retinopathy.
3. Benefit continues even 4 years after stopping intensive therapy

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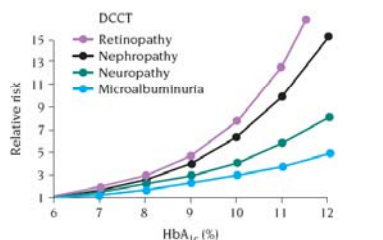
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### Hba1c levels and disease



Relationship of HbA<sub>1c</sub> to risk of microvascular complications. *Endocrinol Metab Clin.* 1996;25:243-254.

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### Risk factors

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### Age- prevalence and severity

- Type I diabetics increase in risk retinopathy with increase in age
- Type II older age group (>30 years) risk of retinopathy decreased with increase in age

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### Gender

- No consistent significant pattern

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### Race/Ethnicity

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### African Americans vs. Whites

- Higher prevalence of retinopathy in African Americans compared to whites
- Three studies
  - National Health and Nutrition Examination Survey III
  - The Atherosclerosis Risk in Communities Study (The ARIC study)
  - The Cardiovascular study
- Differences disappeared or greatly explained by
  - Glycemic levels
  - Blood pressure levels
  - Glycemic control
  - Duration of diabetes and blood pressure

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### Hispanic vs. Whites

- Hispanics greater prevalence of diabetes and diabetic retinopathy
  - Haffner and colleagues
  - NHANES III
  - LALES
- Retinopathy higher 2.4 times in Hispanics (Haffner et al and NHANES III)
- Higher prevalence of proliferative retinopathy and macular edema (LALES)

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### Native Americans vs. Whites

- Native American groups such as Pima Indians
  - May be exposed to higher glycemic levels at younger age
- Higher prevalence of Type II
- More advanced retinopathy for the duration of diabetes

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### Duration of Diabetes

- Strongest predictor of prevalence of retinopathy type I and type II
- WESDR (<30 years of age group)
- Retinopathy
  - 8% at 3 years
  - 25% at 5 years
  - 60% at 10 years
  - 80% at 15 years

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### Hypertension

- Independent risk factor
- UKPDS tight control of blood pressure
  - 37% reduction in risk of micro vascular disease
  - 34% reduction in rate of progression
  - 10 mmHg reduction in systolic blood pressure 10% reduction in risk of retinopathy

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### Other risk factors

- Hyperlipidemia
  - Lipid-lowering therapy may help lower risk of cardiovascular morbidity and possibly retinopathy
- Cigarette smoking and alcohol consumption
  - Inconsistent results
- Obesity at baseline
  - Increases risk of retinopathy and proliferative retinopathy

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**Morbidity and mortality associated with diabetic retinopathy**

- Diabetic retinopathy may reflect systemic vascular dysfunction elsewhere
- Patients with proliferative diabetic retinopathy had
  - Higher risk of myocardial infarction
  - Stroke
  - Nephropathy
  - Lower leg amputation

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**Clinical take home messages**

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- Primary prevention ideal-
- However in absence of methods of primary prevention secondary reduction of risk factors helps
  - Control hyperglycemia
  - Hypertension

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**Glycemic Goals Recommended by the American Diabetes Association**

	Glycemic Goals	Indication for Therapy
<u>Preprandial glucose</u>		
Whole blood	80-120mg/dL	> 140mg/dL or < 80mg/dL
Plasma	90-130mg/dL	> 180mg/dl or < 110mg/dL
<u>Bedtime glucose</u>		
Whole blood	100-140mg/dL	> 160mg/dL or < 100mg/dL
Plasma	110-150mg/dL	> 180mg/dL or < 110mg/dL
<u>Postprandial blood glucose</u>		
	< 180mg/dL	> 180mg/dL
<u>HbA1c</u>		
	< 7%	> 8%

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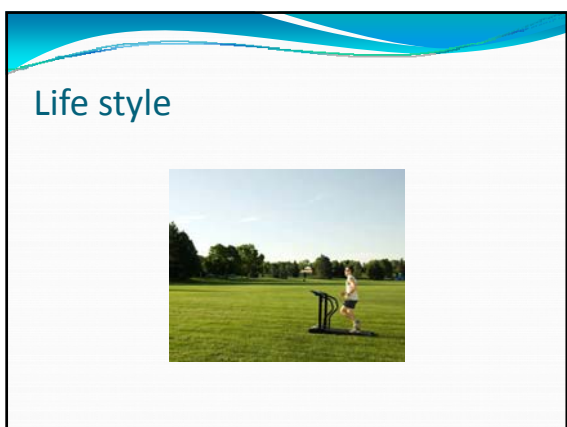
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### Despite best treatment and care

- Retinopathy may progress
- So dilated examination is a must.



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### Duration of diabetes

- 80% of patients will have signs of retinopathy after 15 years of living with diabetes.
- Hyperglycemia is a modifiable risk factor
- 1% reduction in HbA1c is associated with
  - 30% reduction in risk of retinopathy -Type 1
  - 20% reduction in risk of retinopathy -Type 2

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### Hypertension and type -2 DM

- Independent risk factor
- Additive beneficial effect to lowering glucose levels
- 10 mmHg lowering of systolic BP leads to 10% reduction in risk of retinopathy

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