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Exercise & Eat Right for Diabetes Prevention

Linda Macdonald, M.D.

November 12, 2008

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Objectives

- Appreciate the severity of diabetes
- Understand the pathophysiology and epidemiology of diabetes
- Understand the relationship between lifestyle and diabetes
- Understand strategies for diabetes prevention

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Outline

- Why you should be worried about diabetes
- Pathophysiology of diabetes and pre-diabetes
- Epidemiology of diabetes and pre-diabetes
- Risk factors for diabetes and pre-diabetes
- Strategies for diabetes prevention

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Is Diabetes a Serious Disease?

Common consensus:

- No, people with diabetes look perfectly healthy
- No, there are lots of medications to treat diabetes
- No, many people with diabetes don’t even need to take medications
- No, people don’t die from diabetes

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Is Diabetes a Serious Disease?

The truth:

- Yes, diabetes is the leading cause of blindness, kidney failure and non-traumatic amputation
- Yes, diabetes triples the risk of heart attack and stroke
- Yes, diabetes can affect mental health, vision, hearing, dental health, sleep, sexual function, blood pressure, cardiovascular health, kidney function, nerve function, stomach and bowel function, circulation, ….
- Yes, people with diabetes have twice the risk of death as people the same age who don’t have diabetes

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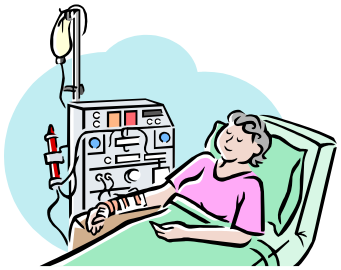
Complications of Diabetes

- Blindness
  - Diabetes is the leading cause of new cases of blindness among adults aged 20 to 74 years, causing 12,000 to 24,000 new cases per year
- Kidney disease
  - Diabetes is the leading cause of kidney failure, accounting for 44% of new cases in 2005
  - In 2005, 46,739 people with diabetes began treatment for end-stage kidney disease



American Diabetes Association

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Complications of Diabetes

- Nervous system disease
  - About 60% to 70% of people with diabetes have mild to severe forms of nervous system damage causing impaired sensation or pain in the feet or hands, slowed digestion of food in the stomach, carpal tunnel syndrome, and other nerve problems
  - More than 60% of non-traumatic lower-limb amputations occur in people with diabetes

American Diabetes Association

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Complications of Diabetes

- Heart disease and stroke
  - Adults with diabetes have heart disease death rates about 2 to 4 times higher than adults without diabetes
  - The risk of stroke is 2 to 4 times higher among people with diabetes

American Diabetes Association

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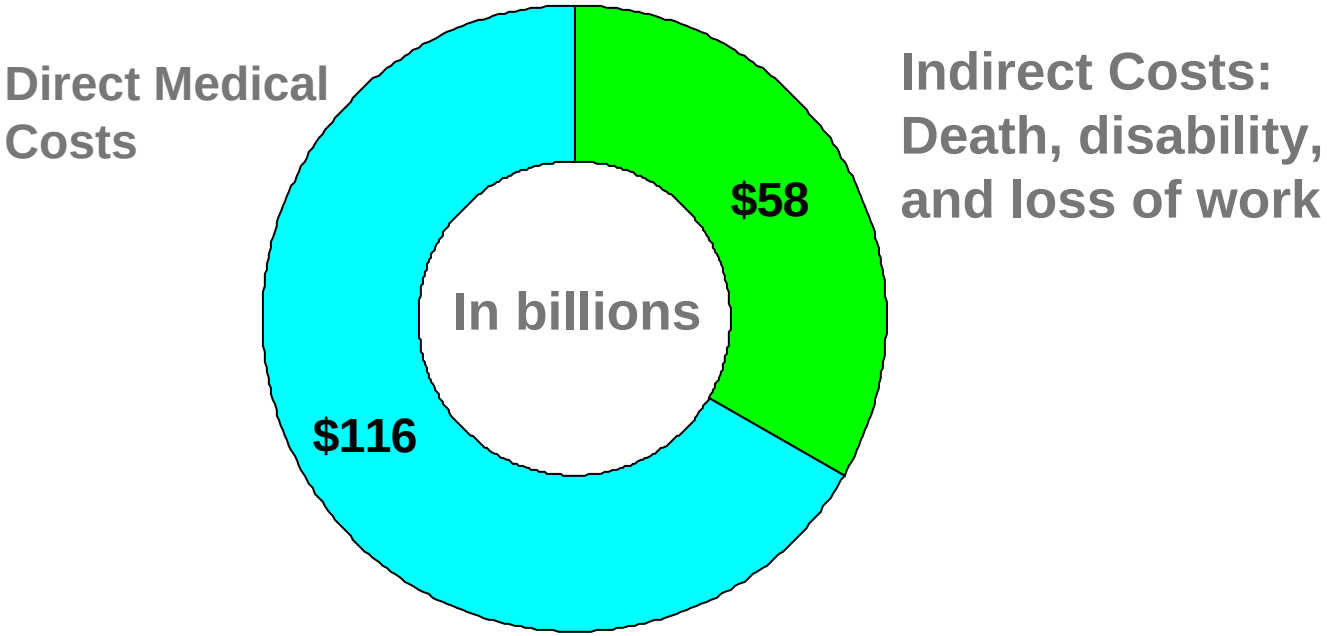
Is Diabetes a Serious Disease?

Estimated cost of diabetes in 2007



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Is Diabetes a Serious Disease?

YES!

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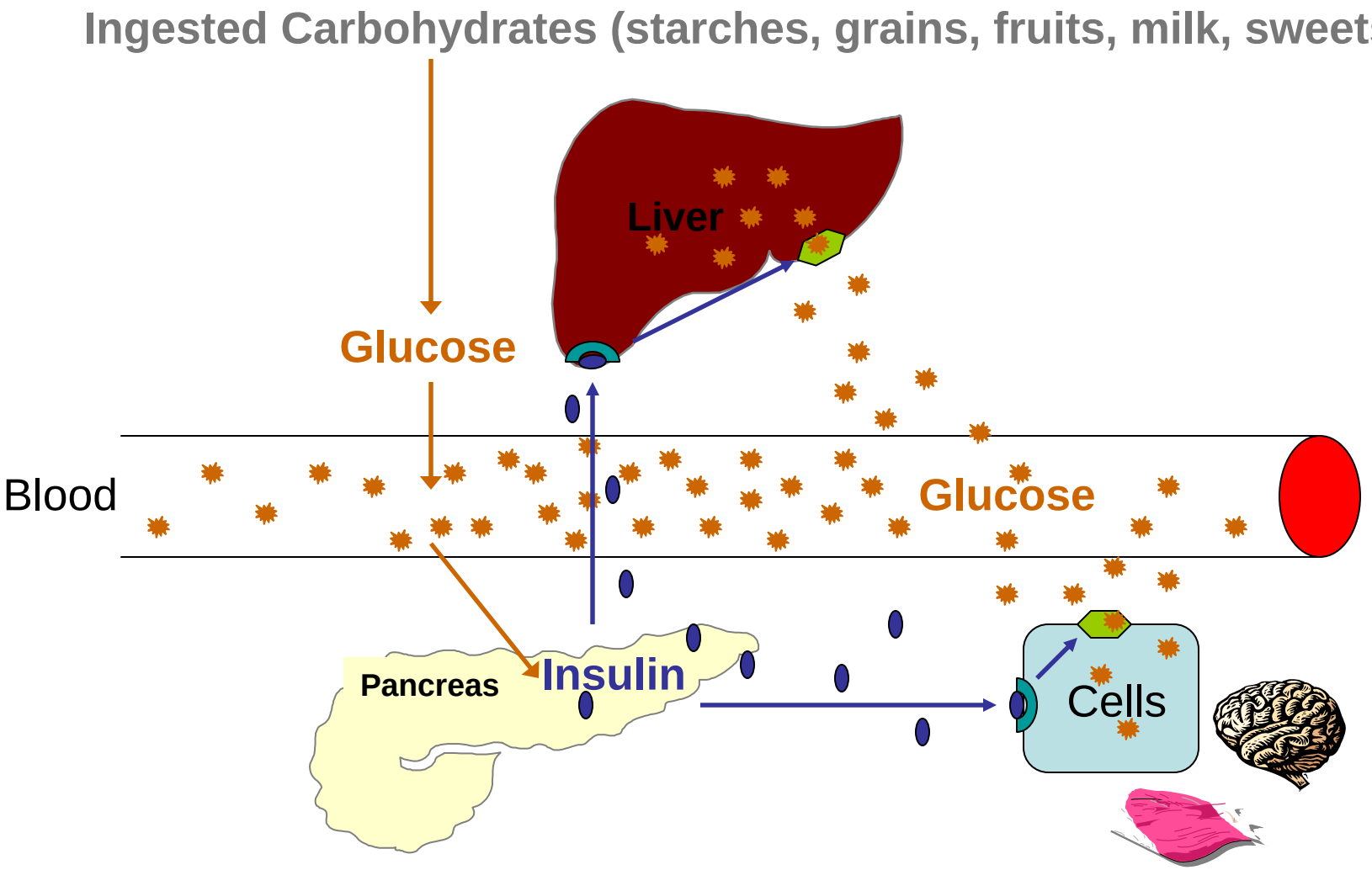
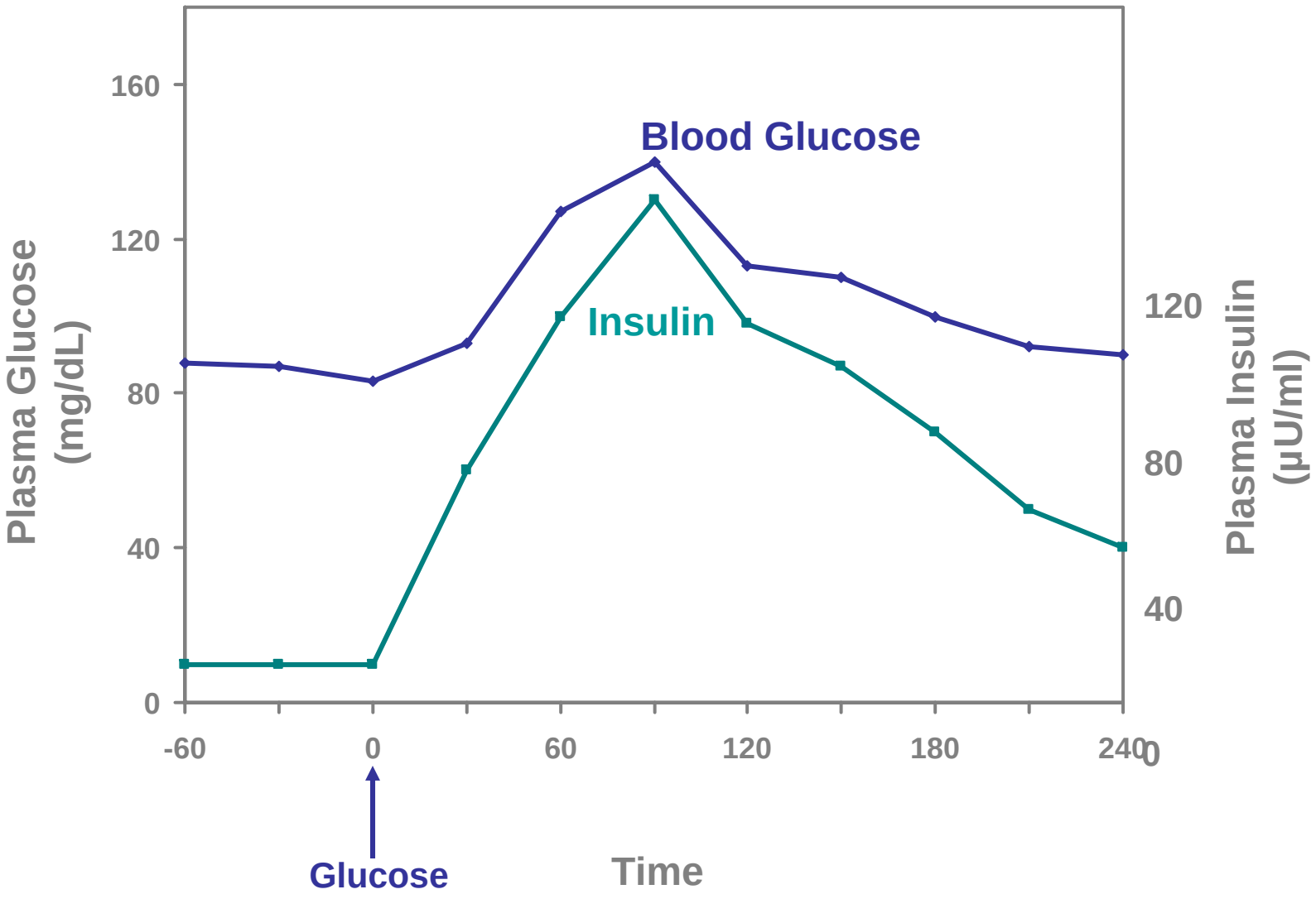
Diabetes & Pre-Diabetes

- Type 2 diabetes is the most common type of diabetes and is the “diabetes” referred to in this talk
- Pre-diabetes pertains only to type 2 diabetes
- Diabetes and pre-diabetes are diseases of glucose metabolism that result in high blood glucose levels
- Blood glucose levels are higher in diabetes than in pre-diabetes

Normal Glucose Metabolism



Normal Insulin Response to Glucose



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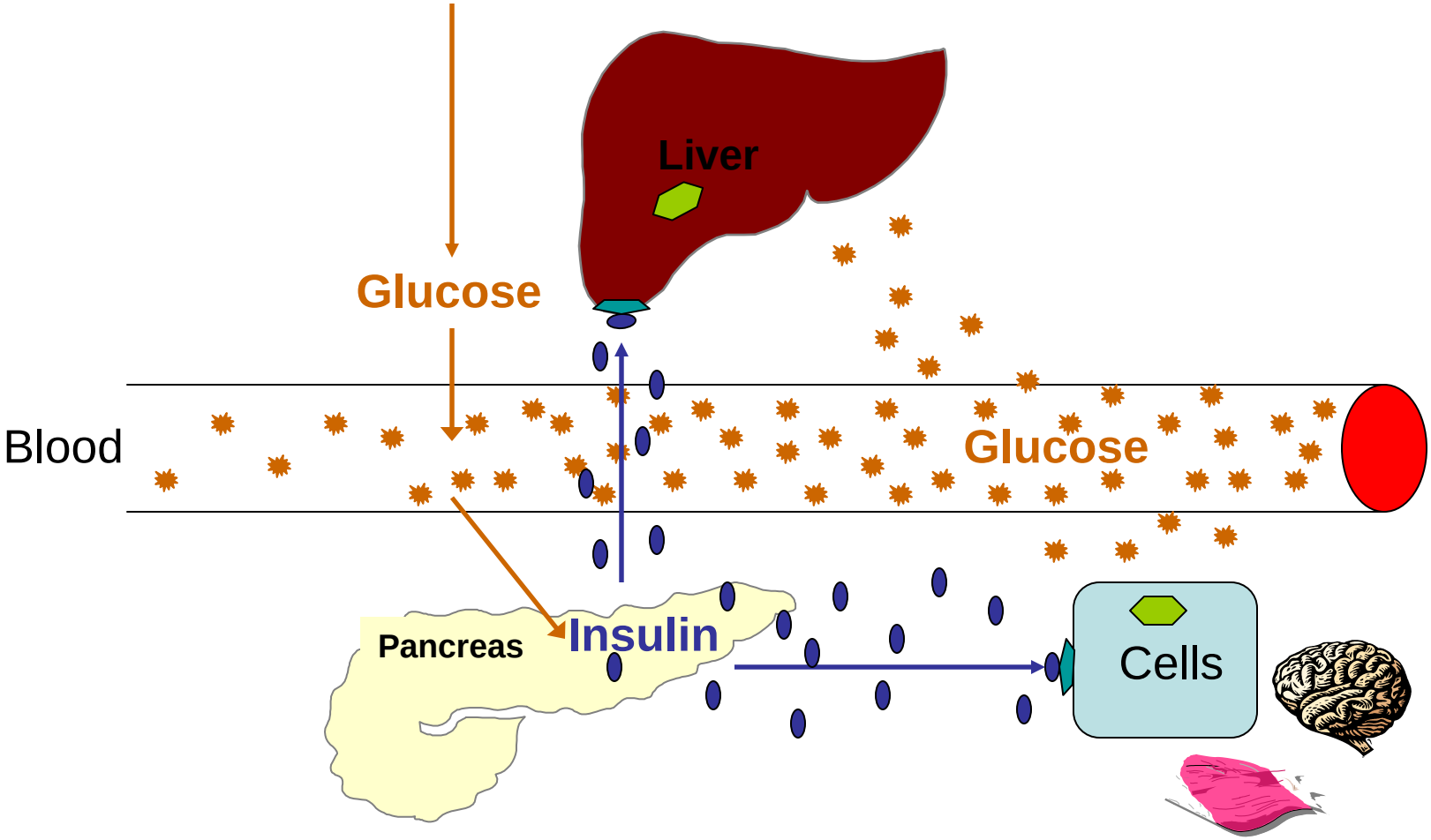
Pre-Diabetes & Diabetes

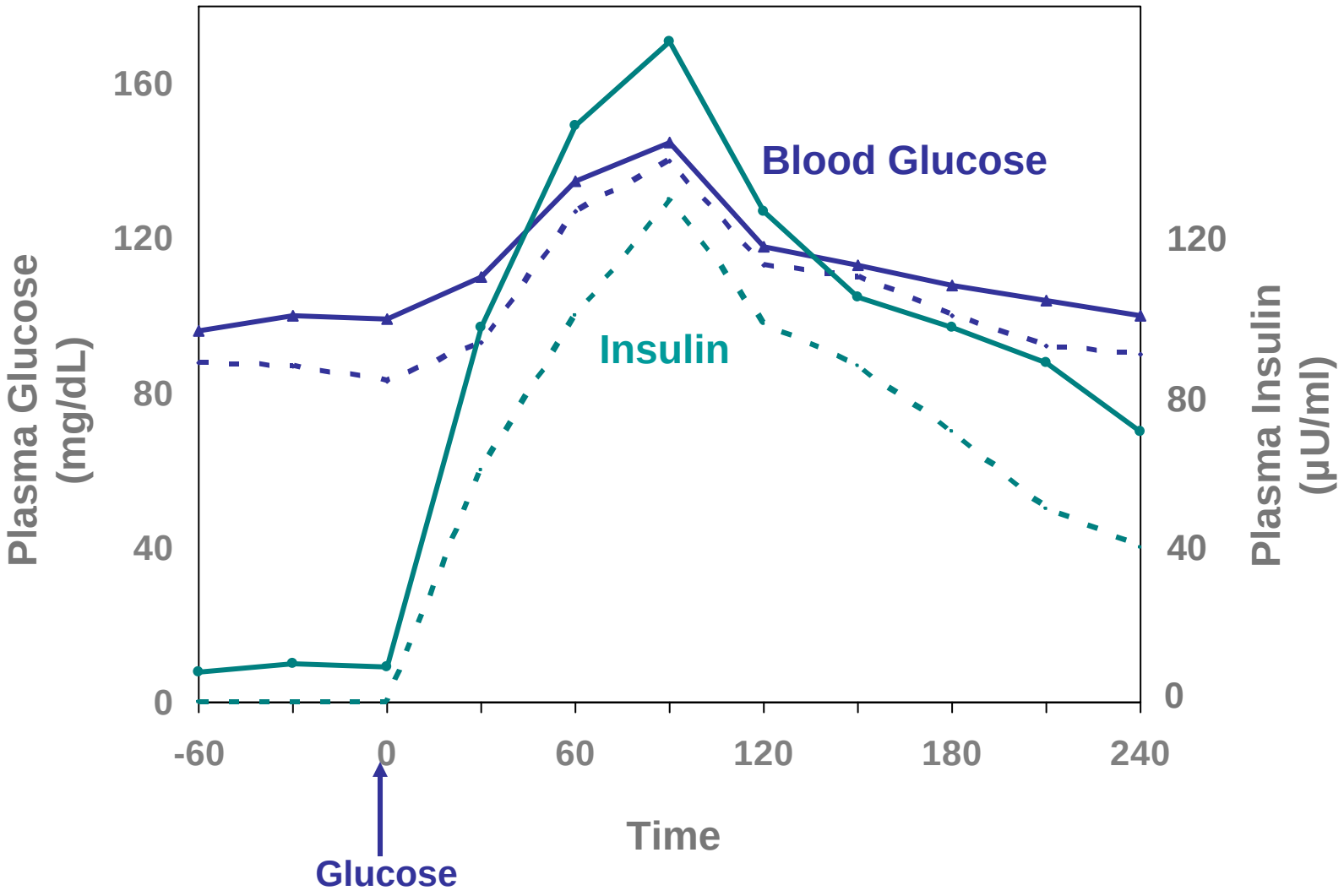
1. Excess body fat causes reduced cellular sensitivity to insulin
   - The cells do not respond to insulin resulting in impaired glucose uptake by the cells
   - The pancreas responds by secreting more insulin

Cellular Insulin Resistance

Ingested Carbohydrates (starches, grains, fruits, milk, sweets)



Cellular Insulin Resistance



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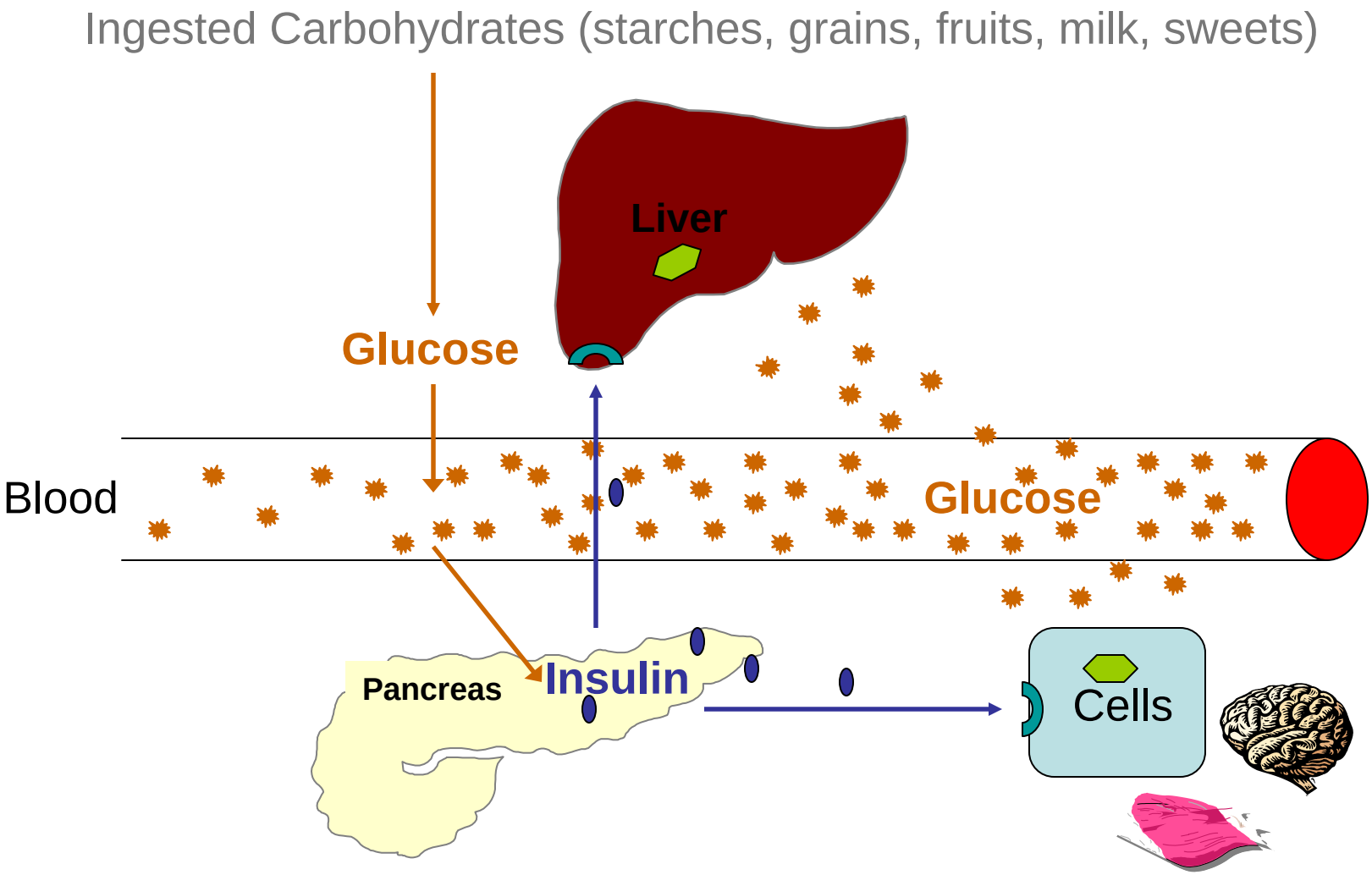
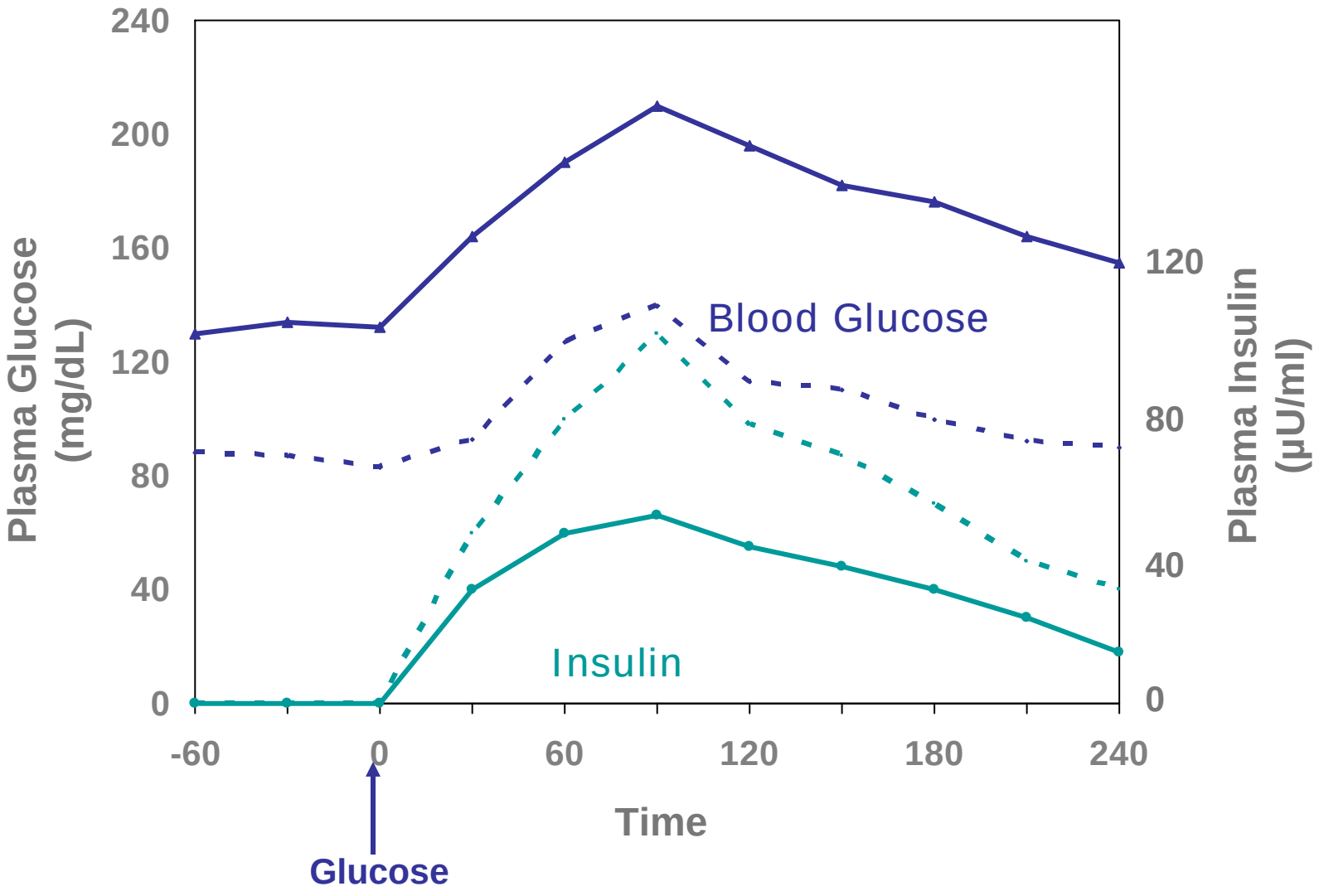
Pre-Diabetes & Diabetes

2. Genetic predisposition causes impaired insulin secretion
   - The pancreas can't keep up with the demand for extra insulin
3. The liver responds by releasing stored glucose

Impaired Insulin Secretion



Cellular Insulin Resistance + Impaired Insulin Secretion



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- **Epidemiology of diabetes and pre-diabetes**
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U.S. Prevalence

- Pre-diabetes estimate for 2007:
  - At least 57 million adults
- Diabetes estimate for 2007:
  - 23.6 million children and adults
  - 7.8% of the population
  - 25% do not know they have diabetes

Centers for Disease Control & Prevention, June 2008

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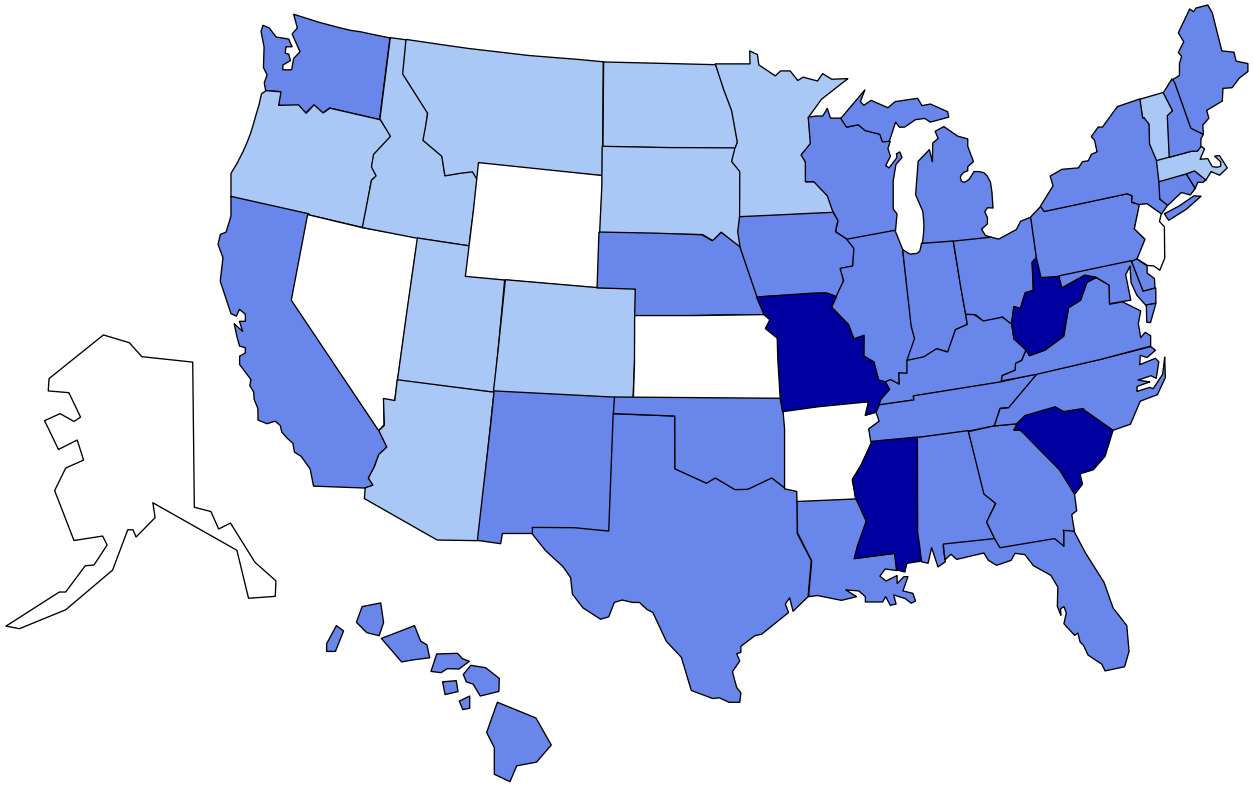
New Mexico

- Approximately 1 in 11 adults in NM has diabetes
- American Indians are 3 times more likely to have diagnosed diabetes than non-Hispanic Whites
- Hispanics and Blacks are 2 times more likely to have diagnosed diabetes than non-Hispanic Whites

New Mexico Department of Health, 2005

Diabetes and Gestational Diabetes Trends Among Adults in the U.S., BRFSS 1990

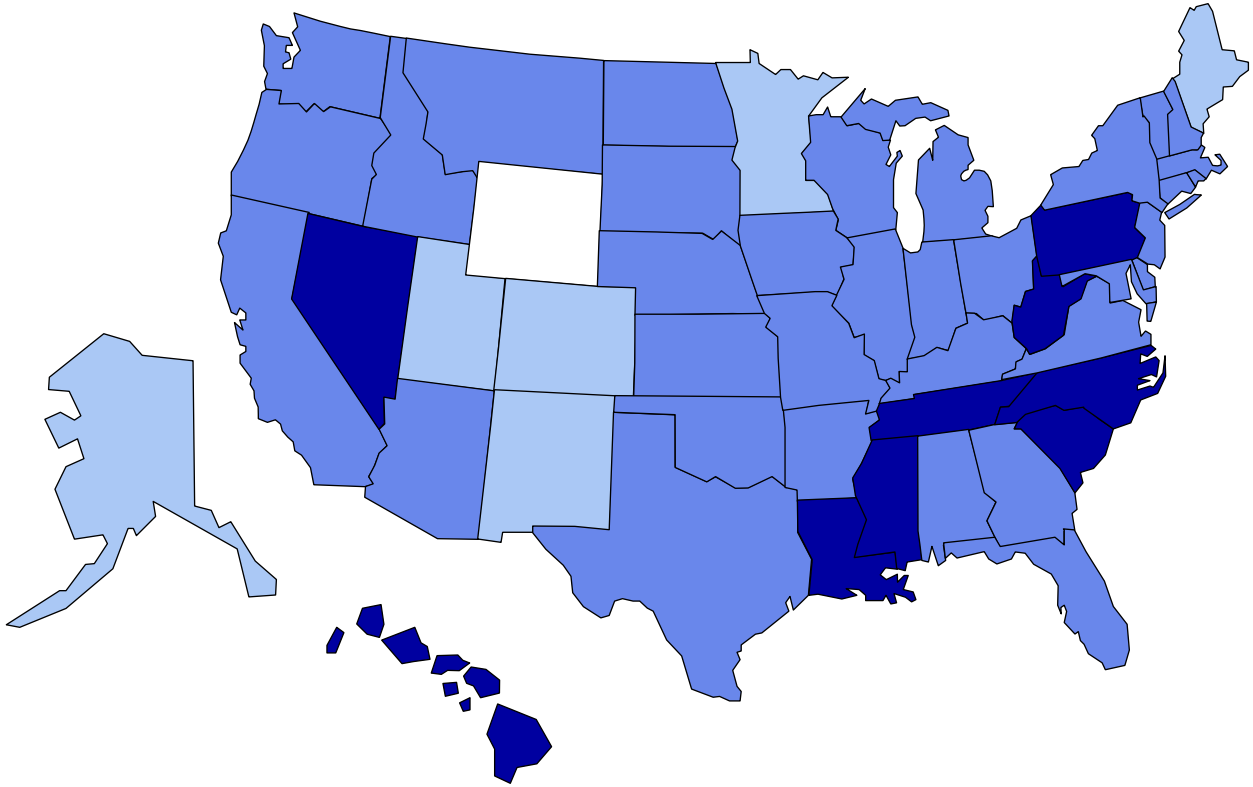


No Data | <4% | 4-6% | 6-8% | 8-10% | >10%

Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and other obesity-related health risk factors, 2001. JAMA 2003 Jan 1;289(1).

CDC

Diabetes and Gestational Diabetes Trends Among Adults in the U.S., BRFSS 1991-92



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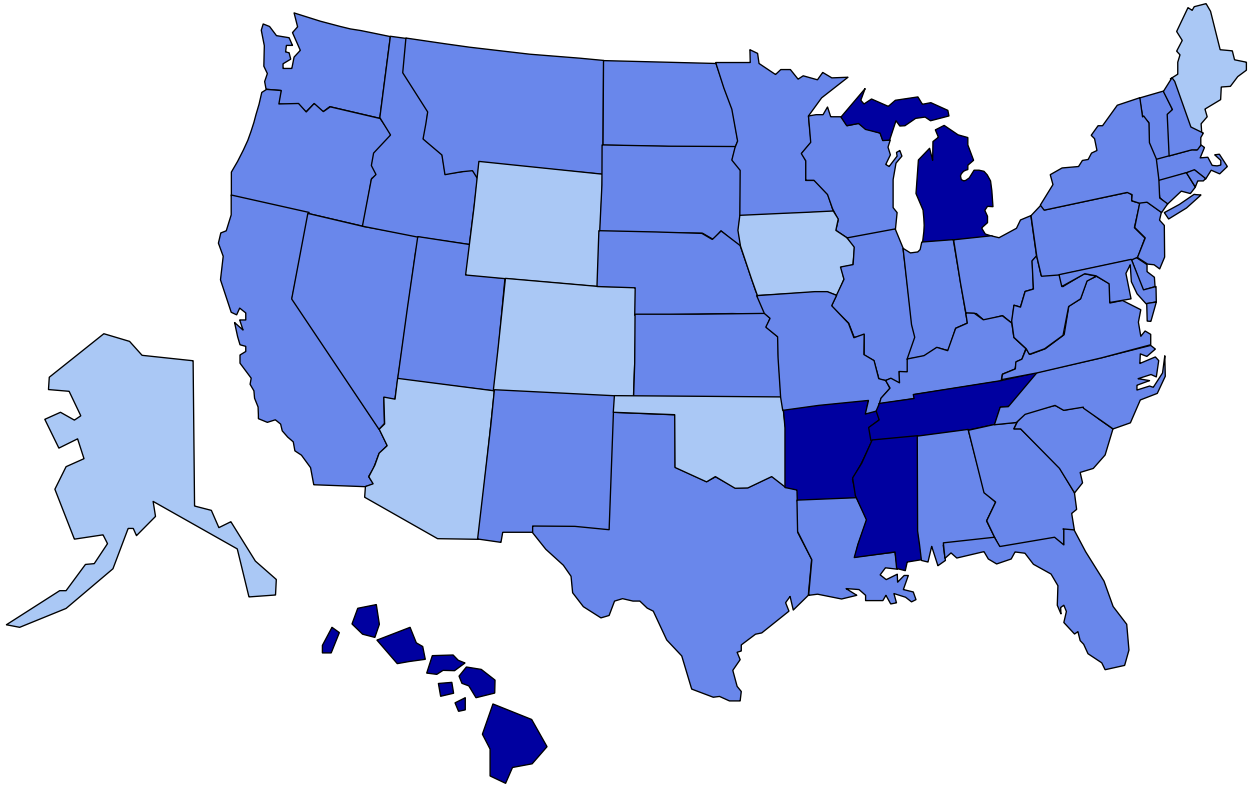
Diabetes and Gestational Diabetes Trends Among Adults in the U.S., BRFSS 1993-94



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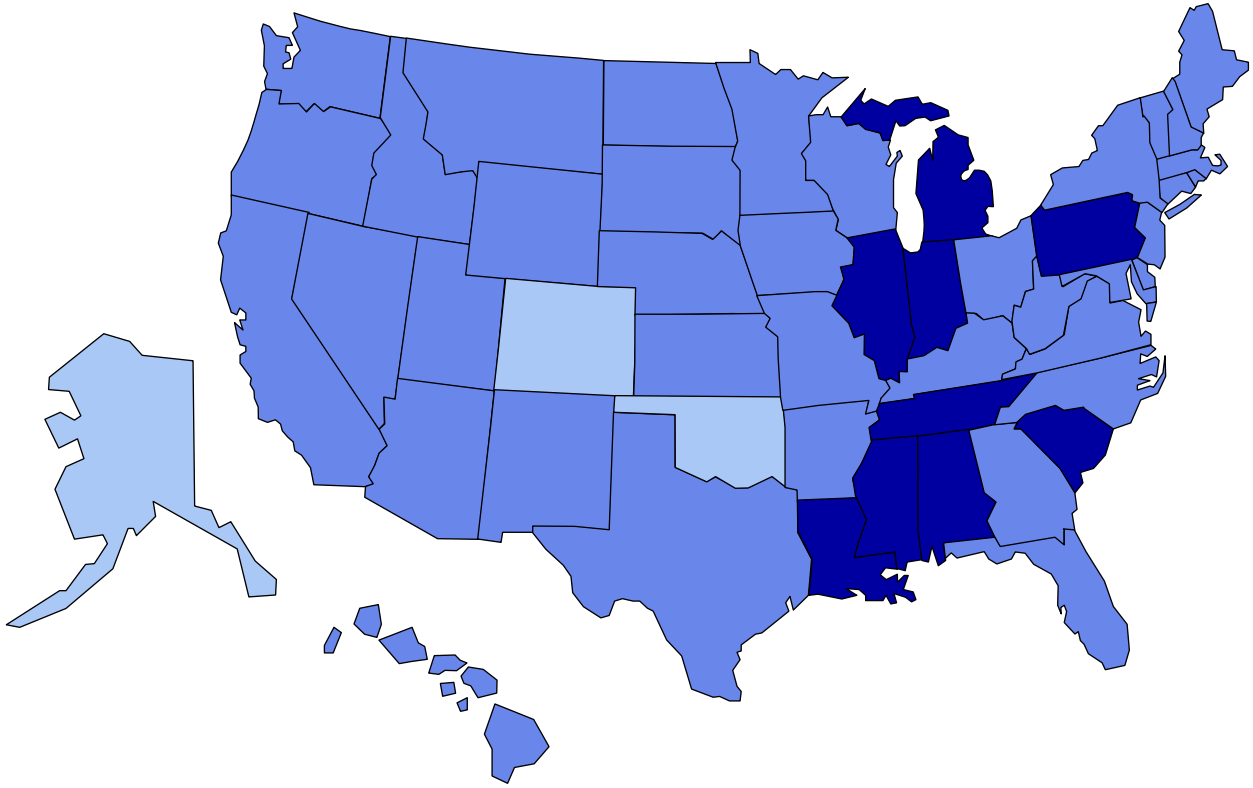
Diabetes and Gestational Diabetes Trends Among Adults in the U.S., BRFSS 1995-96



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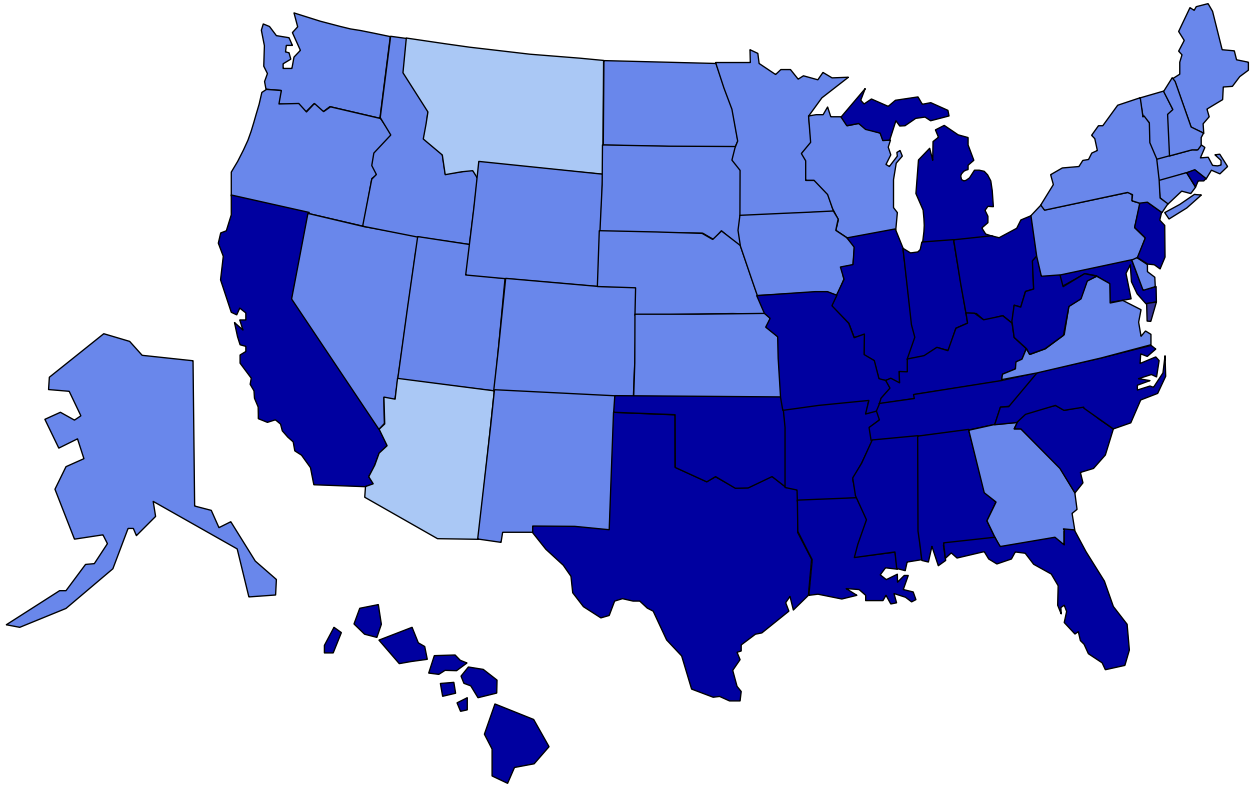
Diabetes and Gestational Diabetes Trends Among Adults in the U.S., BRFSS 1997-98



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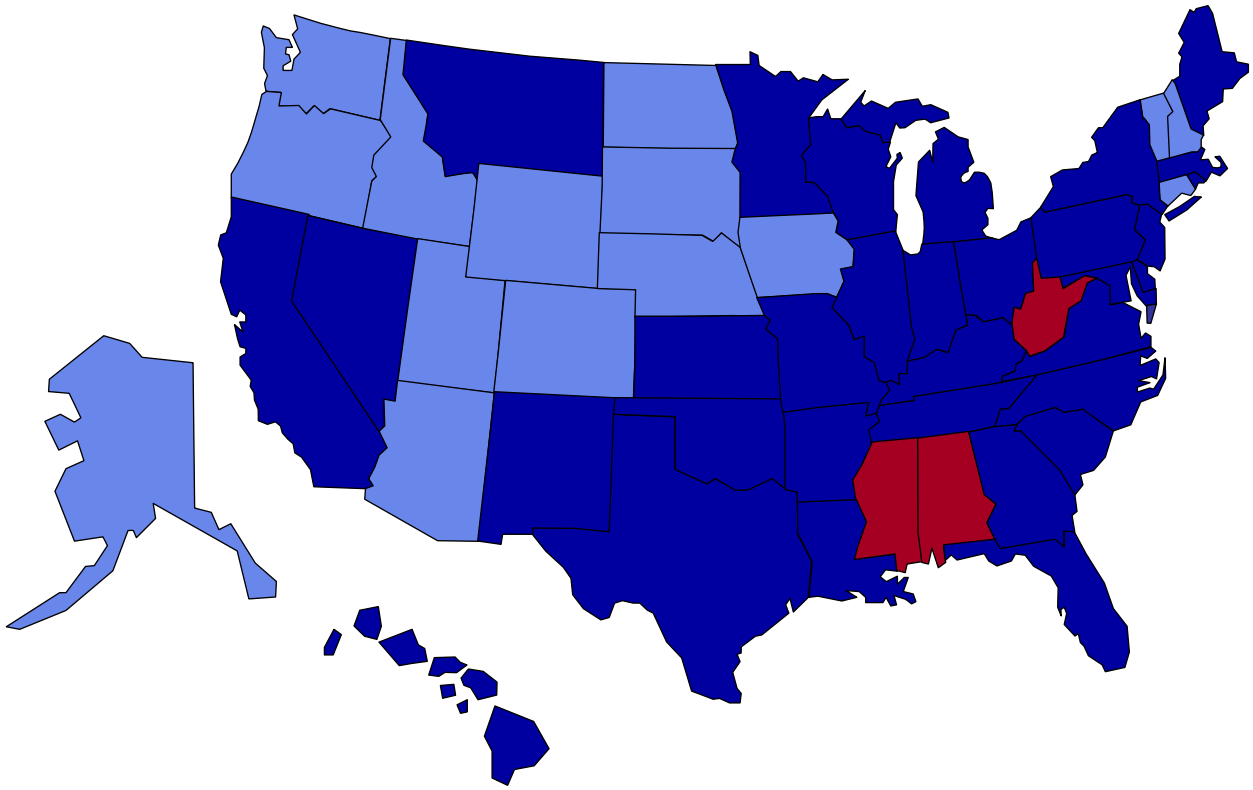

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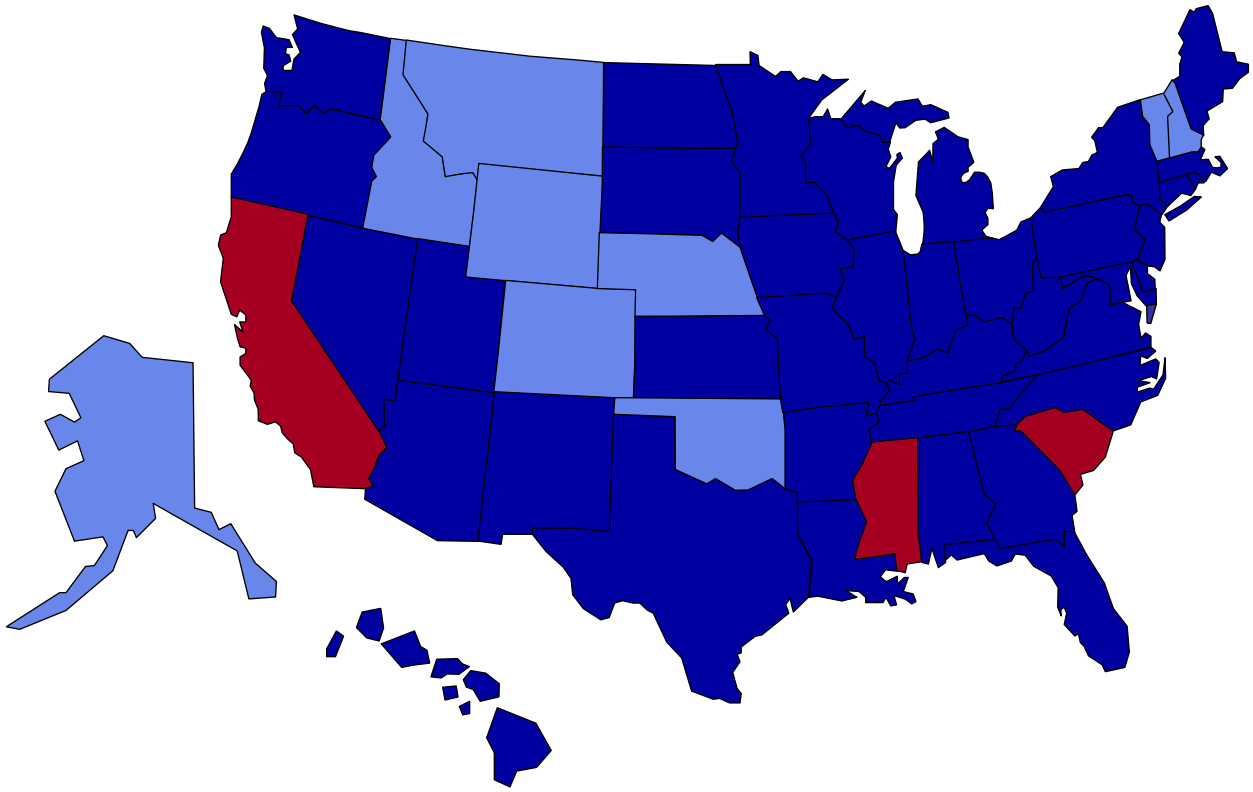
Diabetes and Gestational Diabetes Trends Among Adults in the U.S., BRFSS 2000



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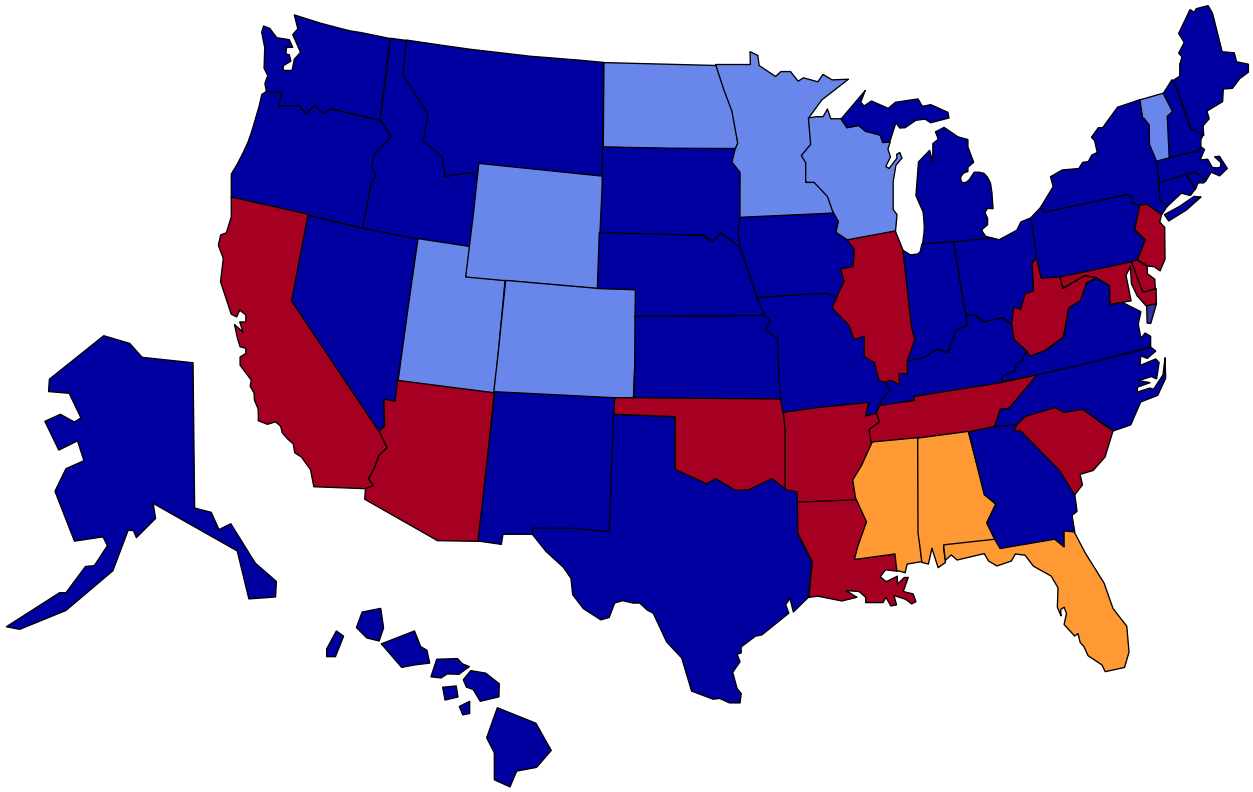

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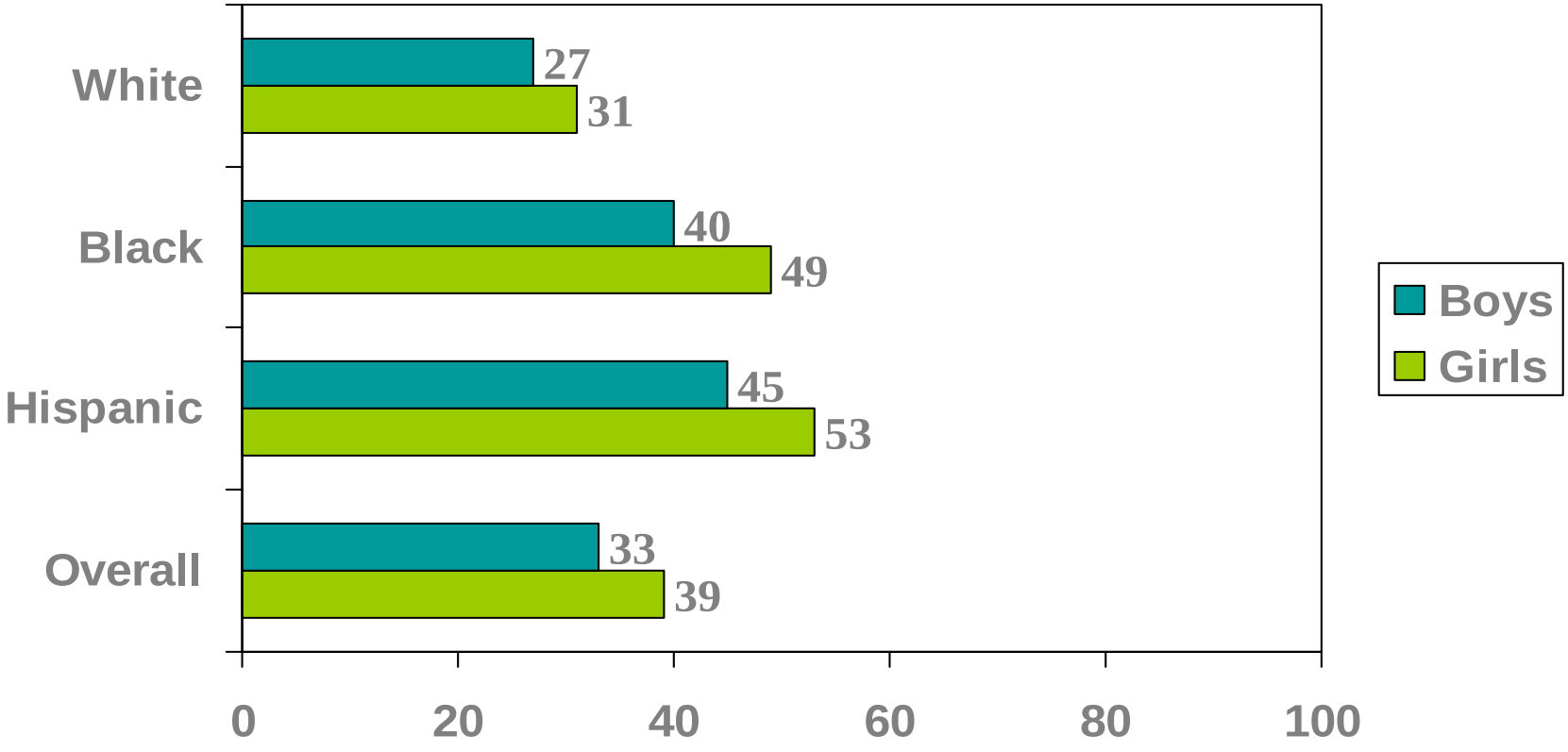
CDC

Diabetes in the Future



Lifetime Risk of Diabetes for Children Born in 2000

Narayan KMV et al, JAMA, 2003

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Risk Factors

You're at risk for pre-diabetes/diabetes if you:

- Are overweight or obese
- Are physically inactive
- Have a parent, brother, or sister with diabetes
- Are Black, American Indian, Asian American, Pacific Islander, or Hispanic American
- Have had a baby weighing more than 9 pounds or have had gestational diabetes
- Have high blood pressure (over 140/90 mmHg)
- Have low HDL cholesterol (35 mg/dl or lower) or high triglycerides (250 mg/dl or higher)

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Type 2 Diabetes & Weight

Obesity is the strongest risk factor for diabetes:

- 9 out of 10 people with newly diagnosed diabetes are overweight or obese
- A weight gain of 11 to 18 pounds increases a person's risk of developing type 2 diabetes to twice that of individuals who have not gained weight.
- It is estimated that 27% of new cases of diabetes are attributable to weight gain in adulthood of 11 pounds or more
- Abdominal obesity is a major risk factor for type 2 diabetes

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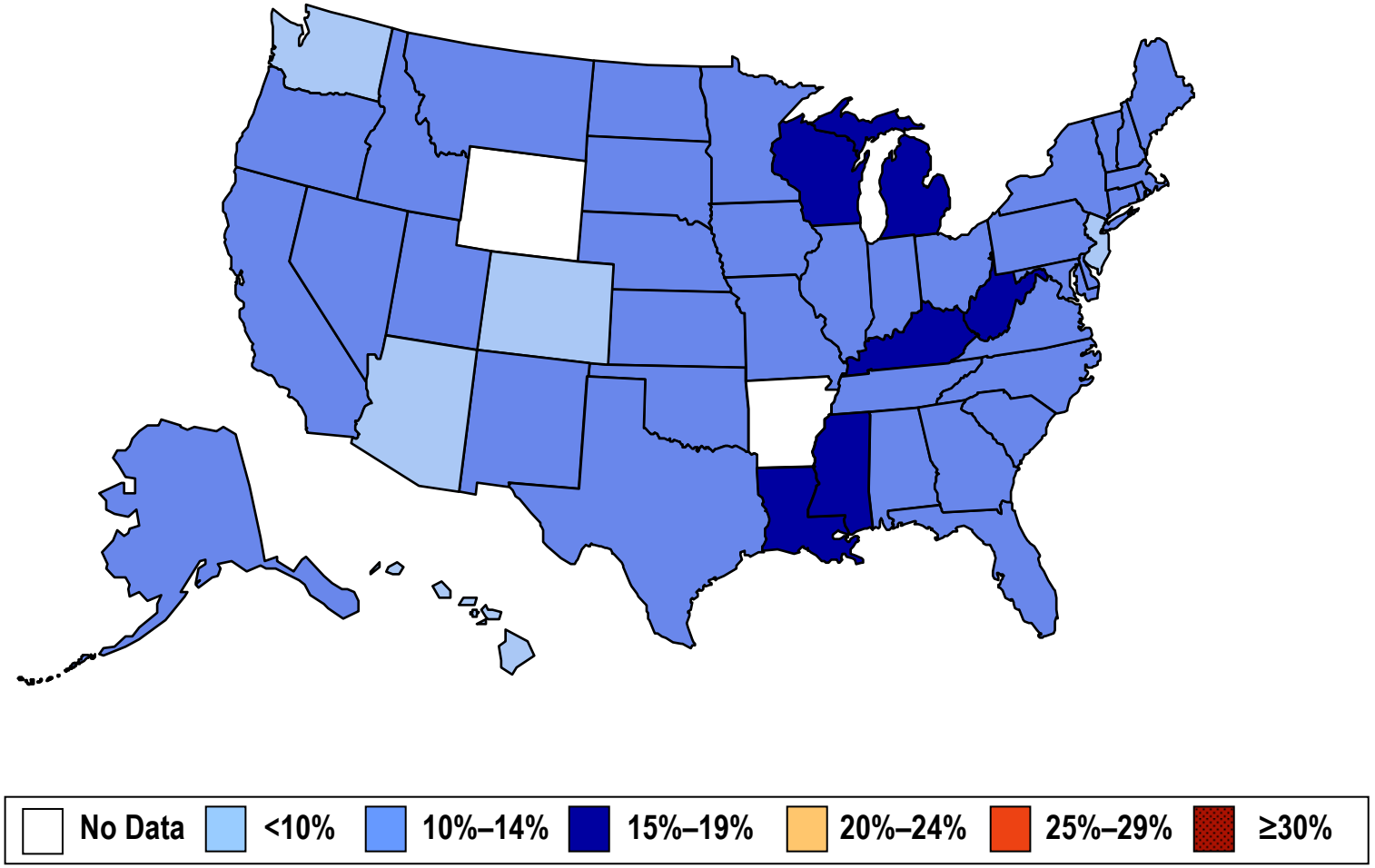
Overweight and Obesity

- **The prevalence of overweight and obesity have increased dramatically over the past several decades**

Obesity Trends* Among U.S. Adults BRFSS, 1992

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



Obesity Trends* Among U.S. Adults BRFSS, 1993

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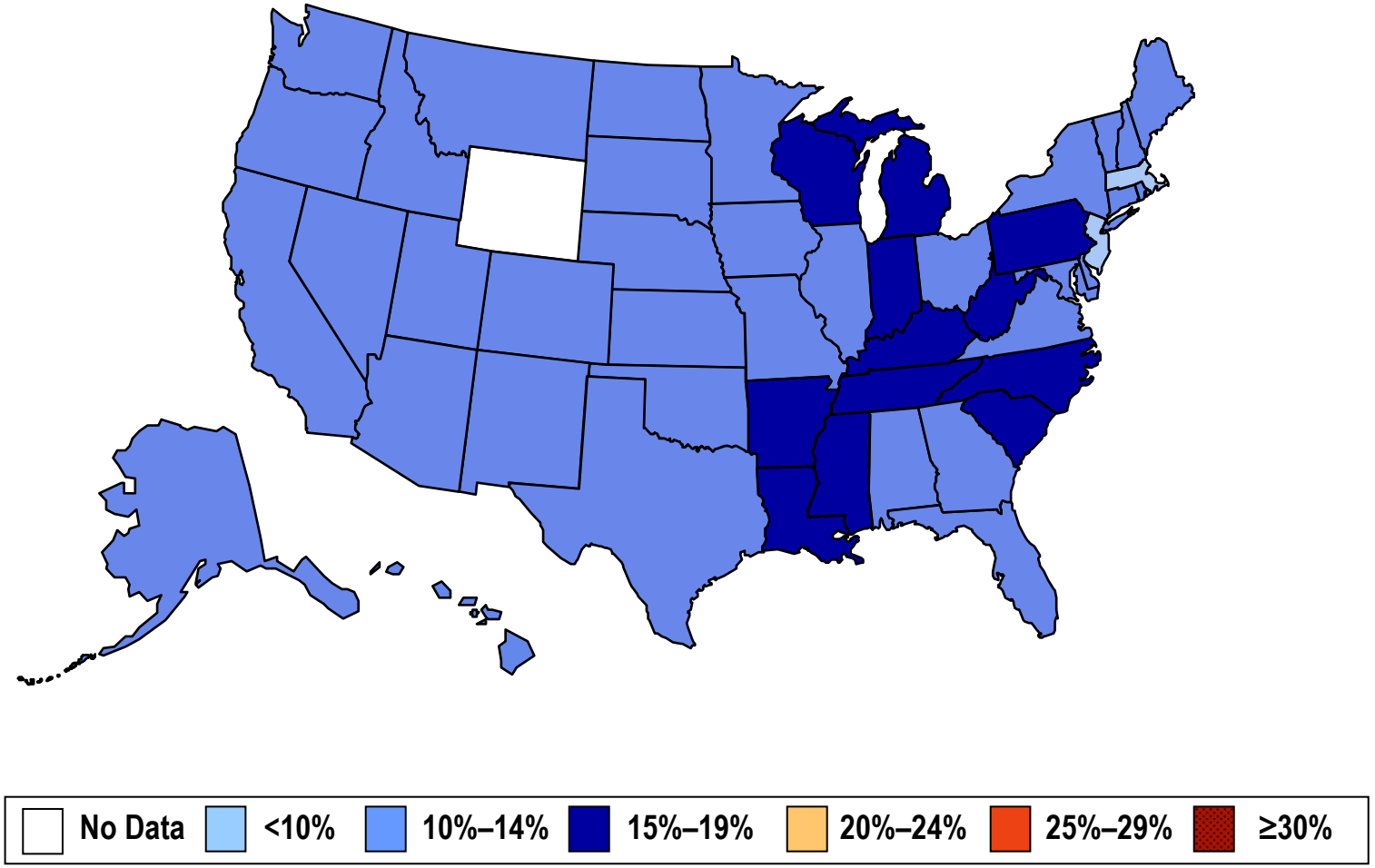

Obesity Trends* Among U.S. Adults BRFSS, 1994

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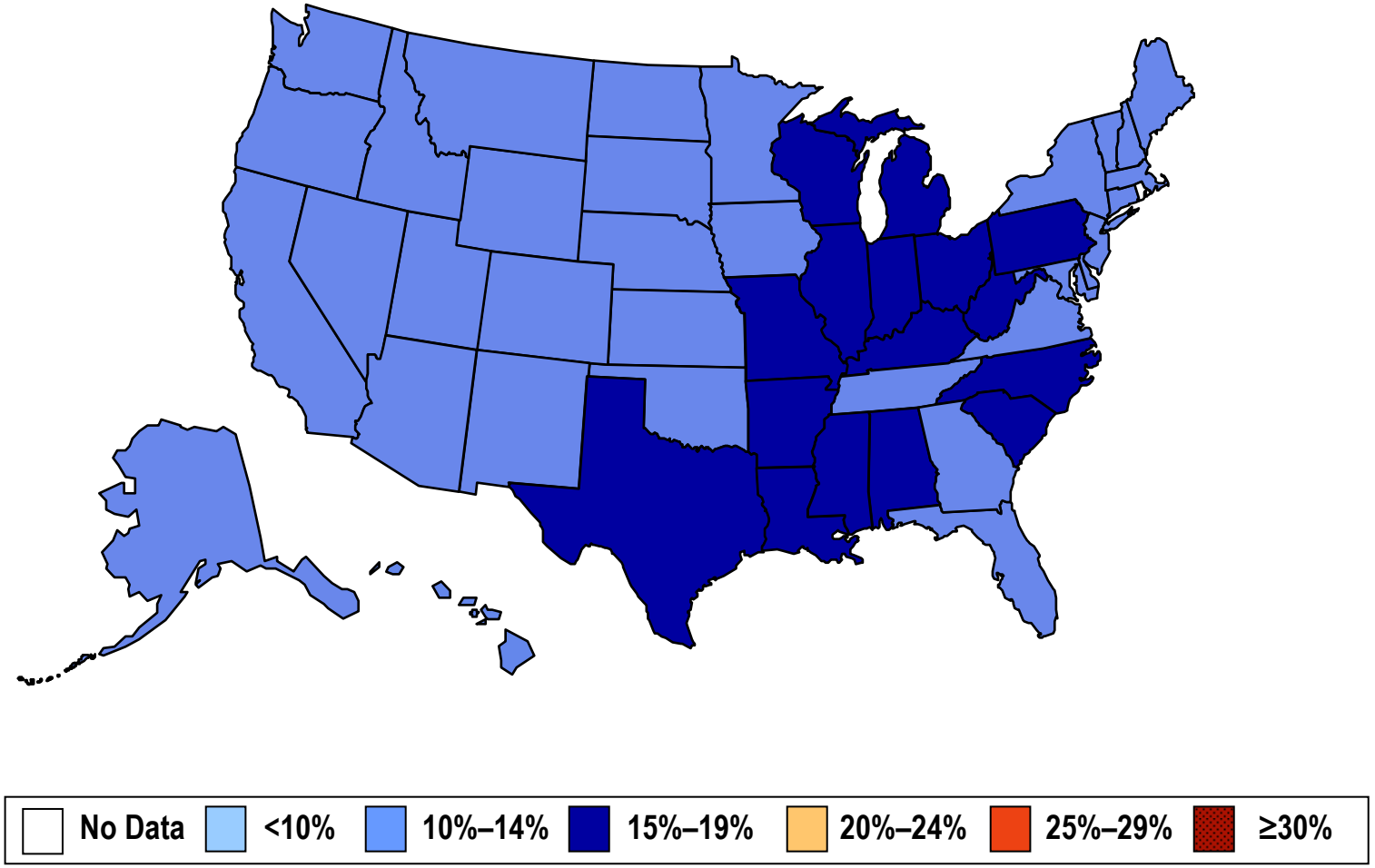

Obesity Trends* Among U.S. Adults BRFSS, 1995

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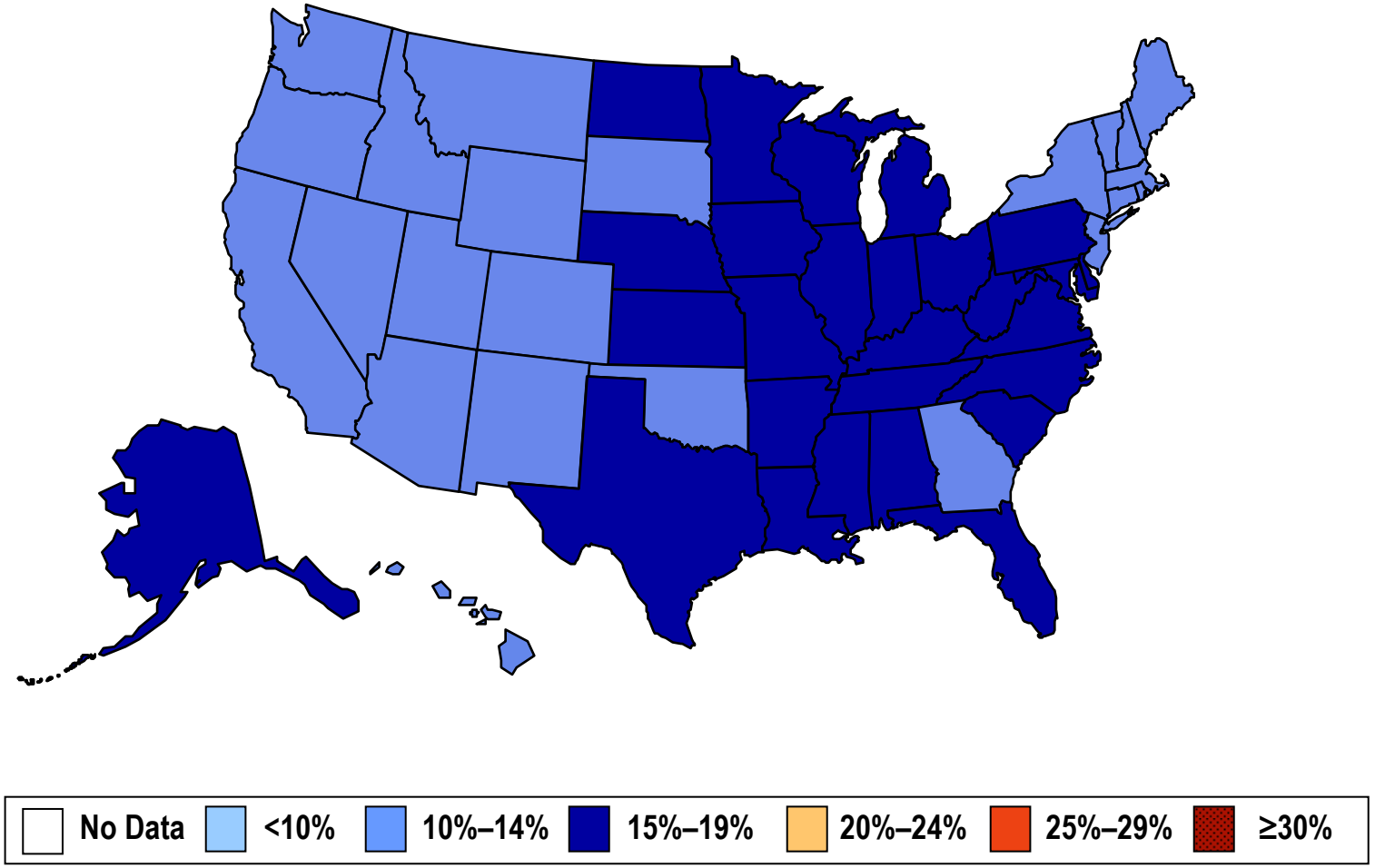

Obesity Trends* Among U.S. Adults BRFSS, 1996

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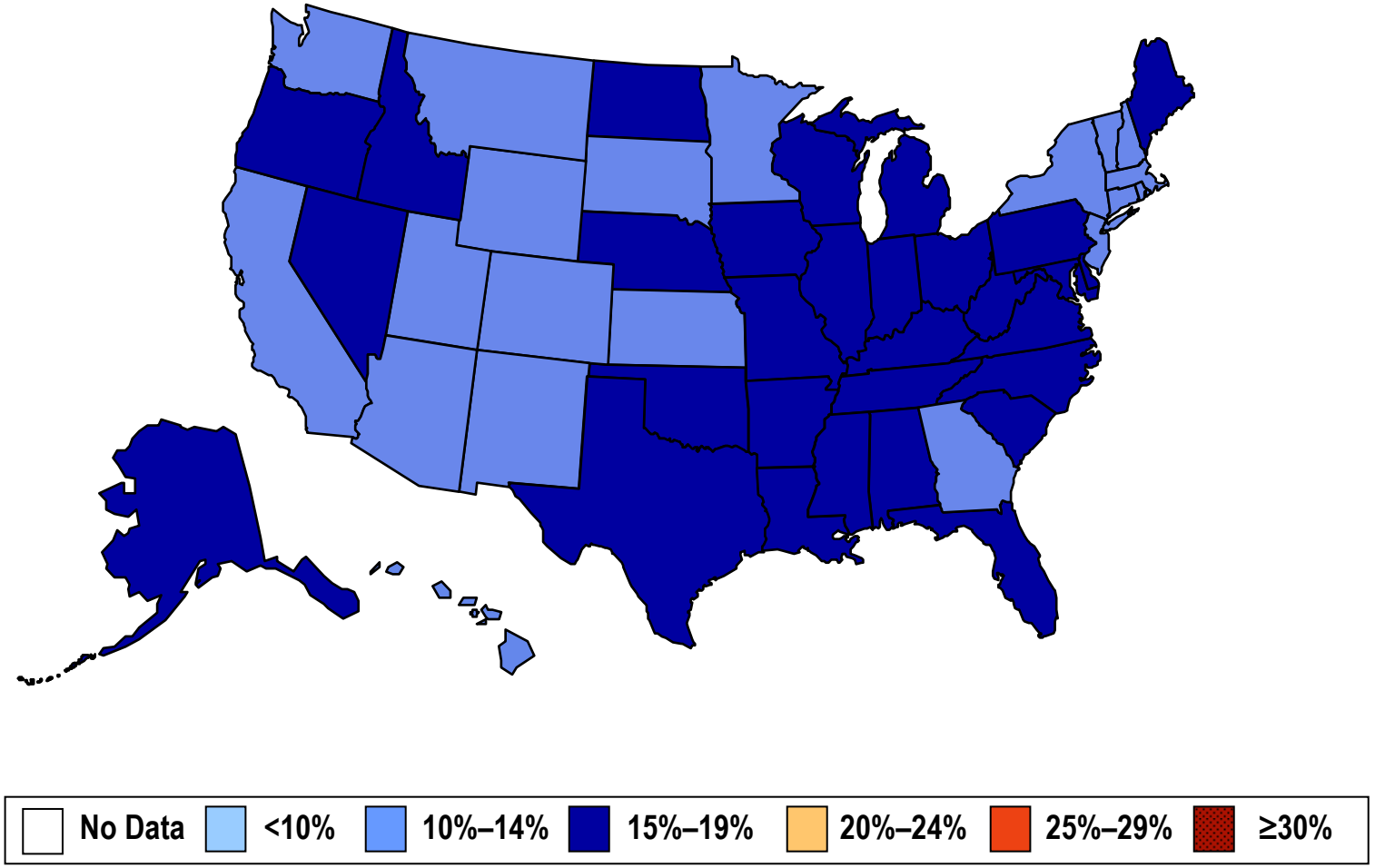

Obesity Trends* Among U.S. Adults BRFSS, 1997

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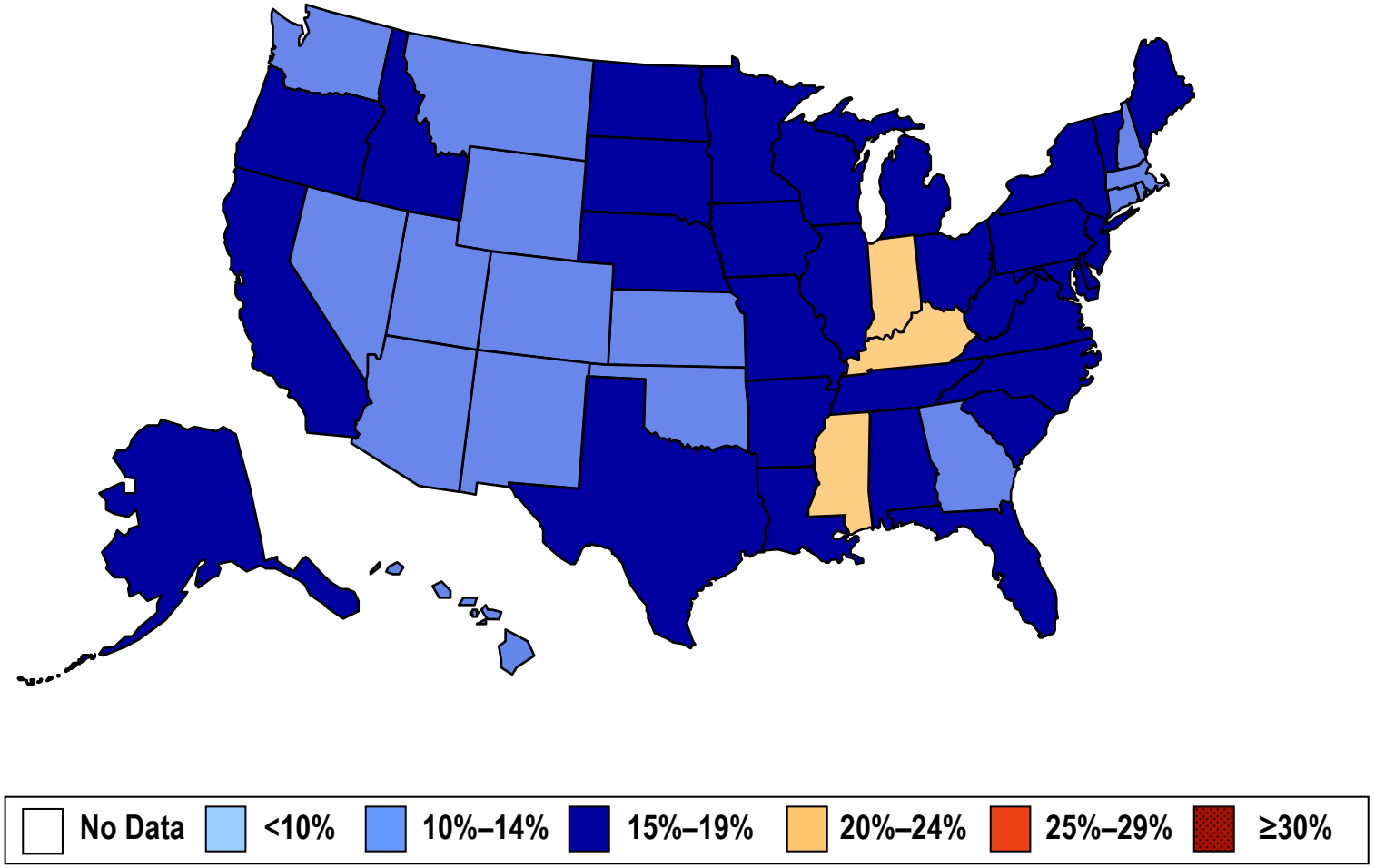

Obesity Trends* Among U.S. Adults BRFSS, 1998

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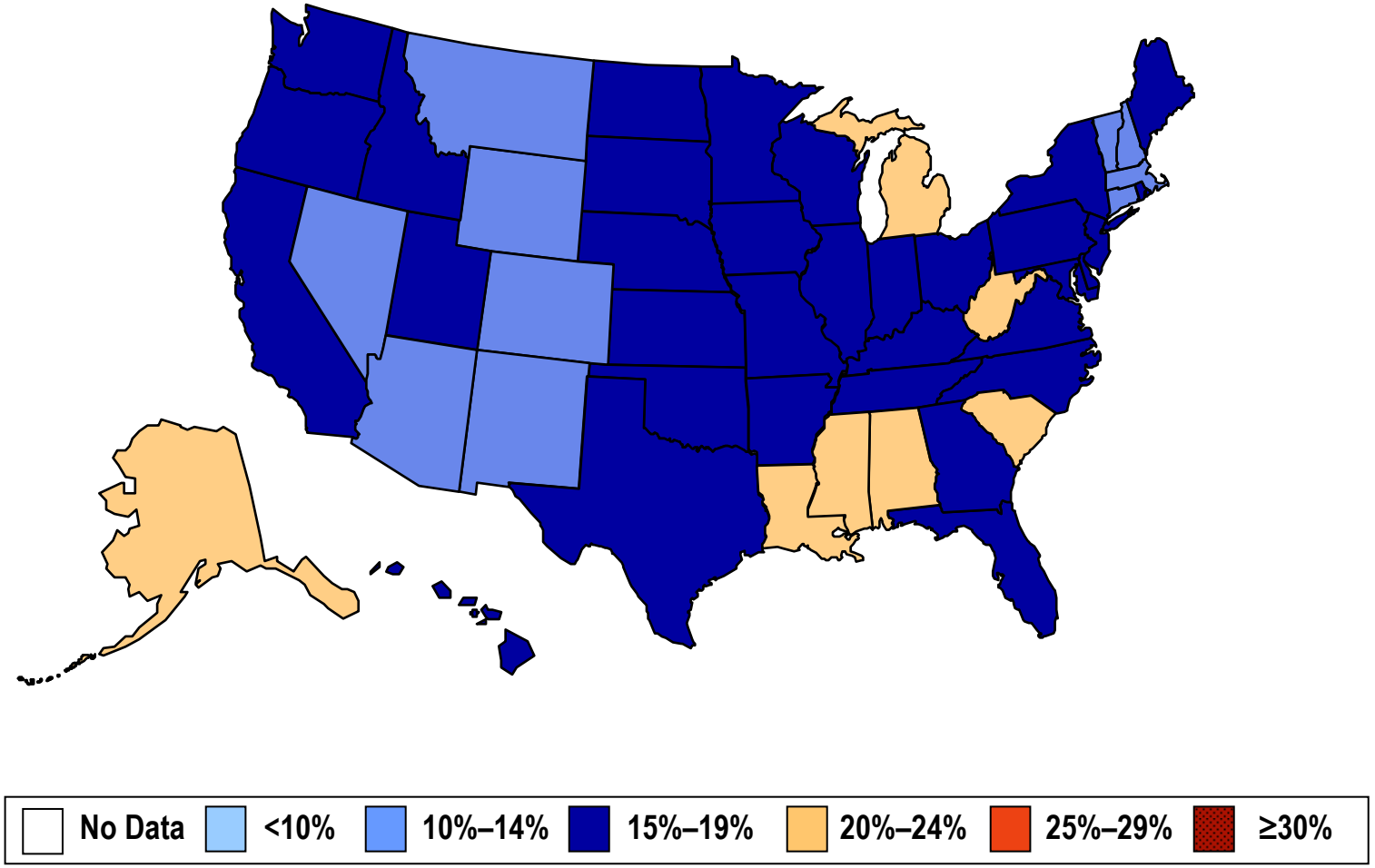

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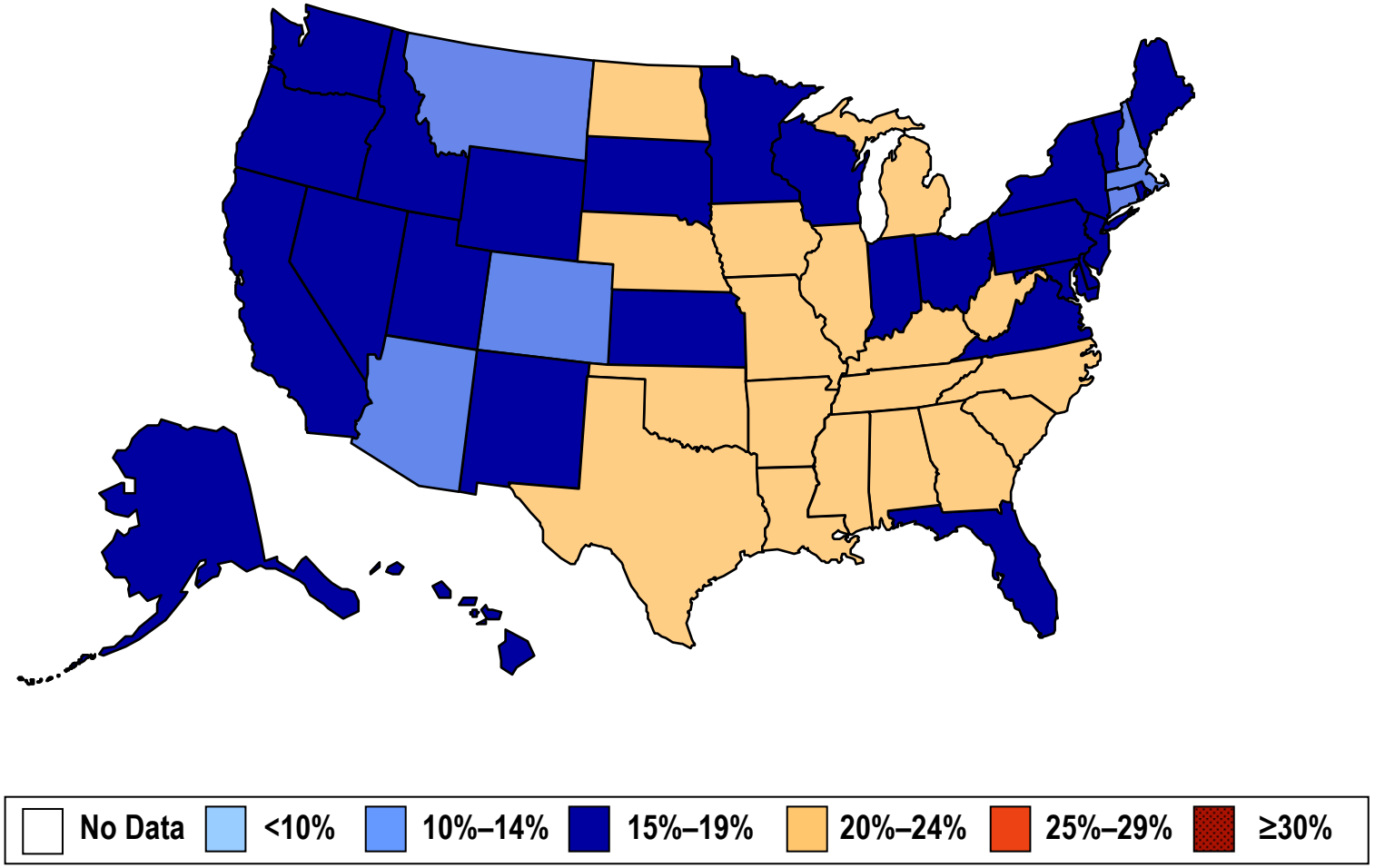

Obesity Trends* Among U.S. Adults BRFSS, 2000

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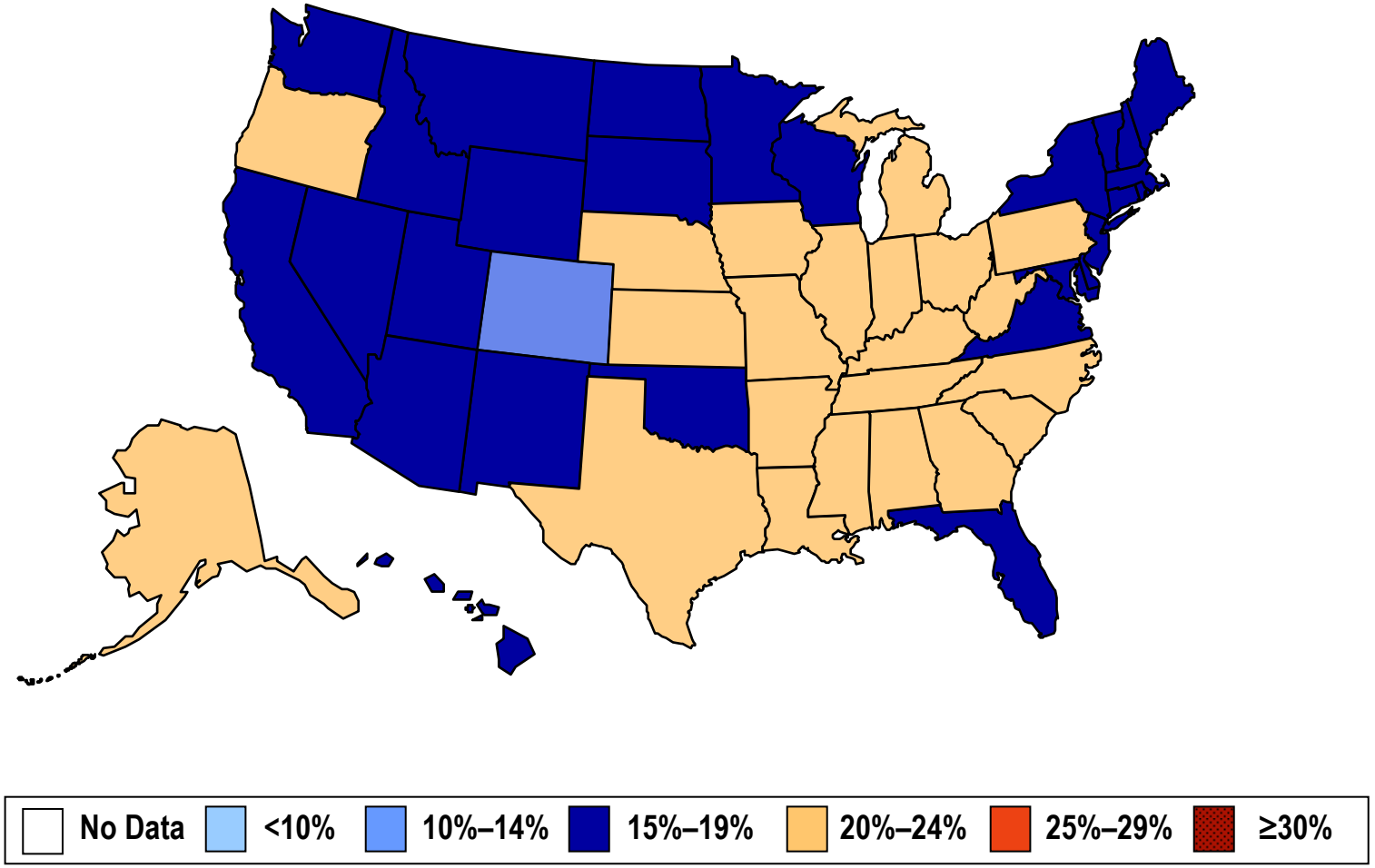

Obesity Trends* Among U.S. Adults BRFSS, 2001

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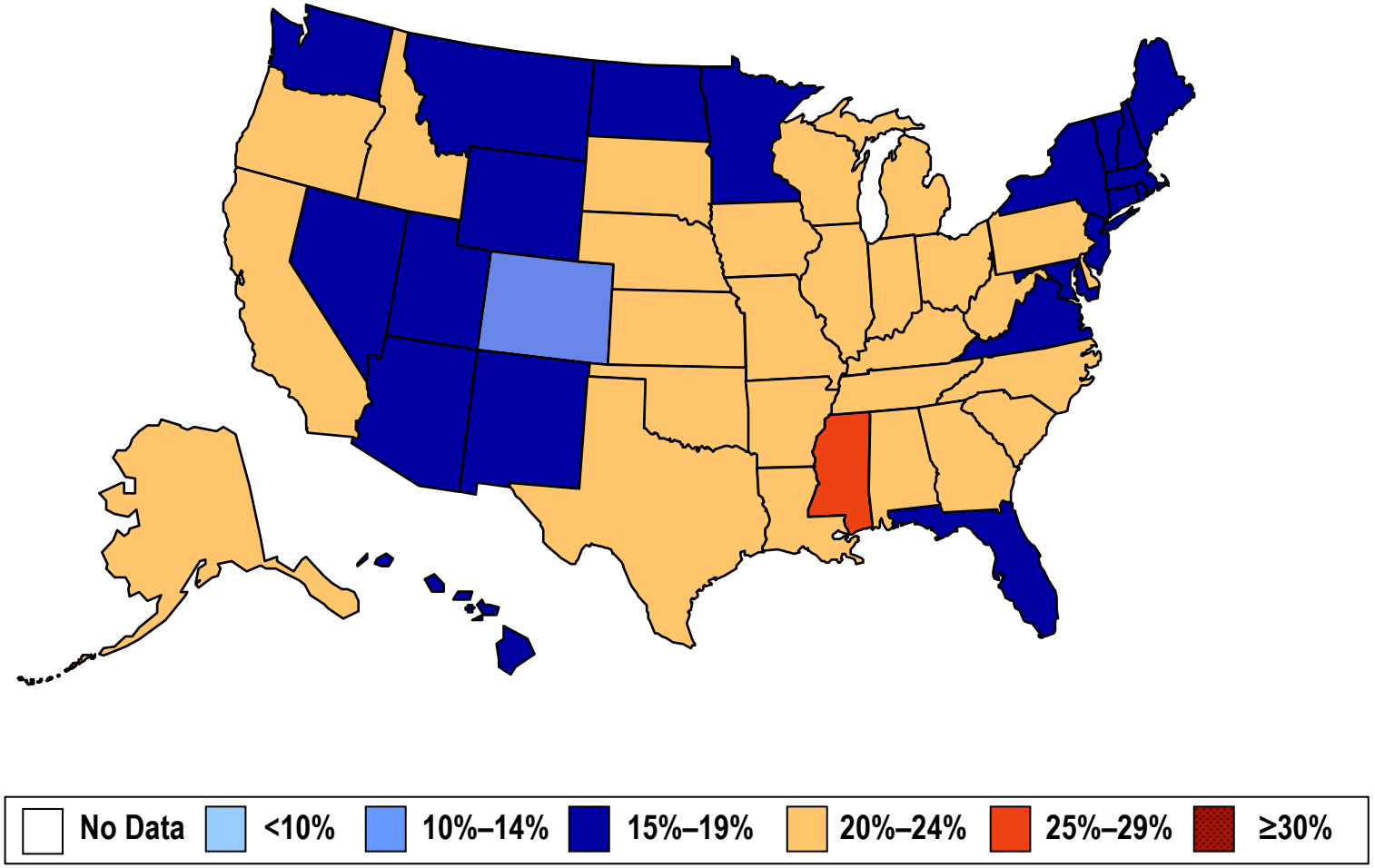

Obesity Trends* Among U.S. Adults BRFSS, 2002

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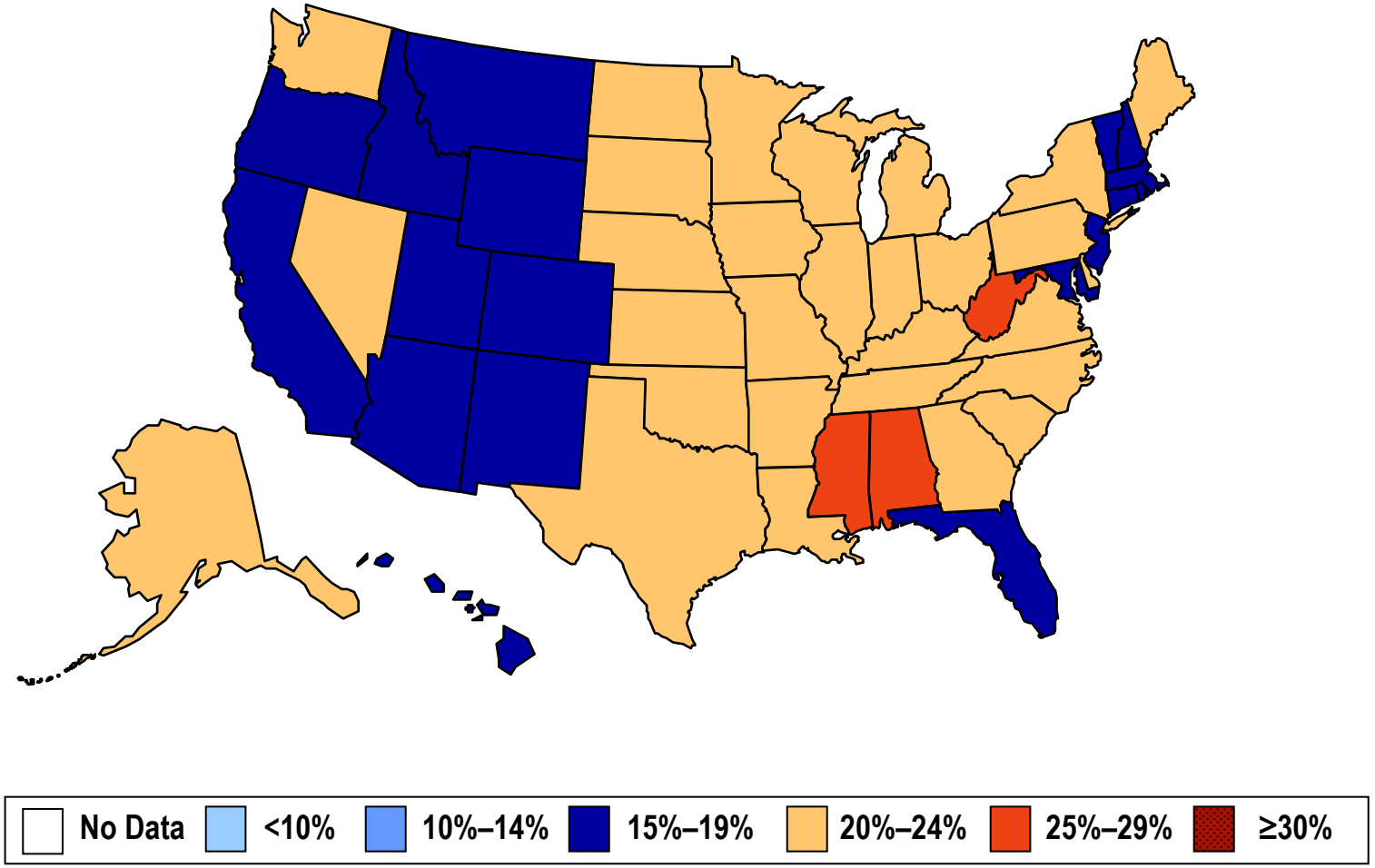

Obesity Trends* Among U.S. Adults BRFSS, 2003

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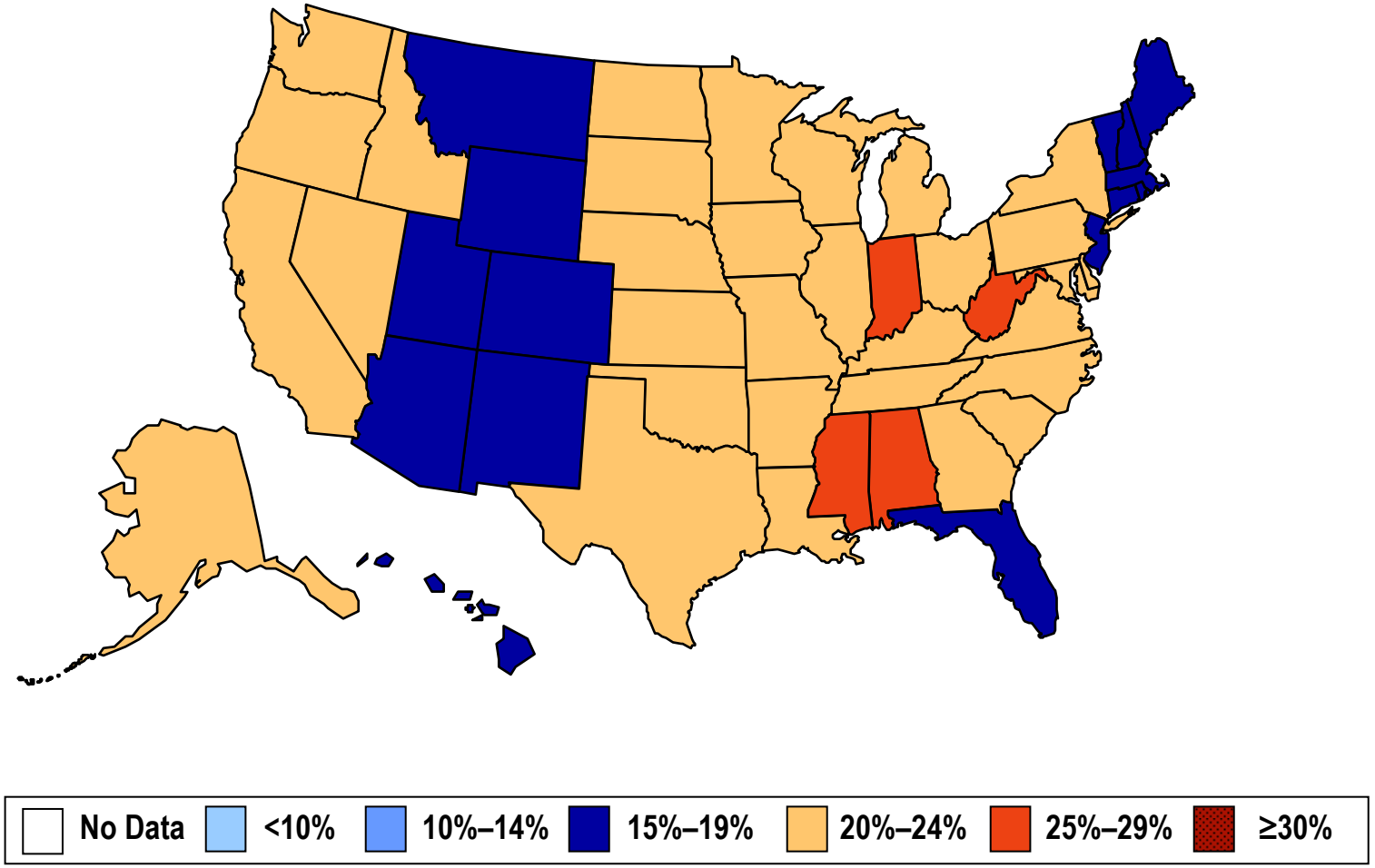

Obesity Trends* Among U.S. Adults BRFSS, 2004

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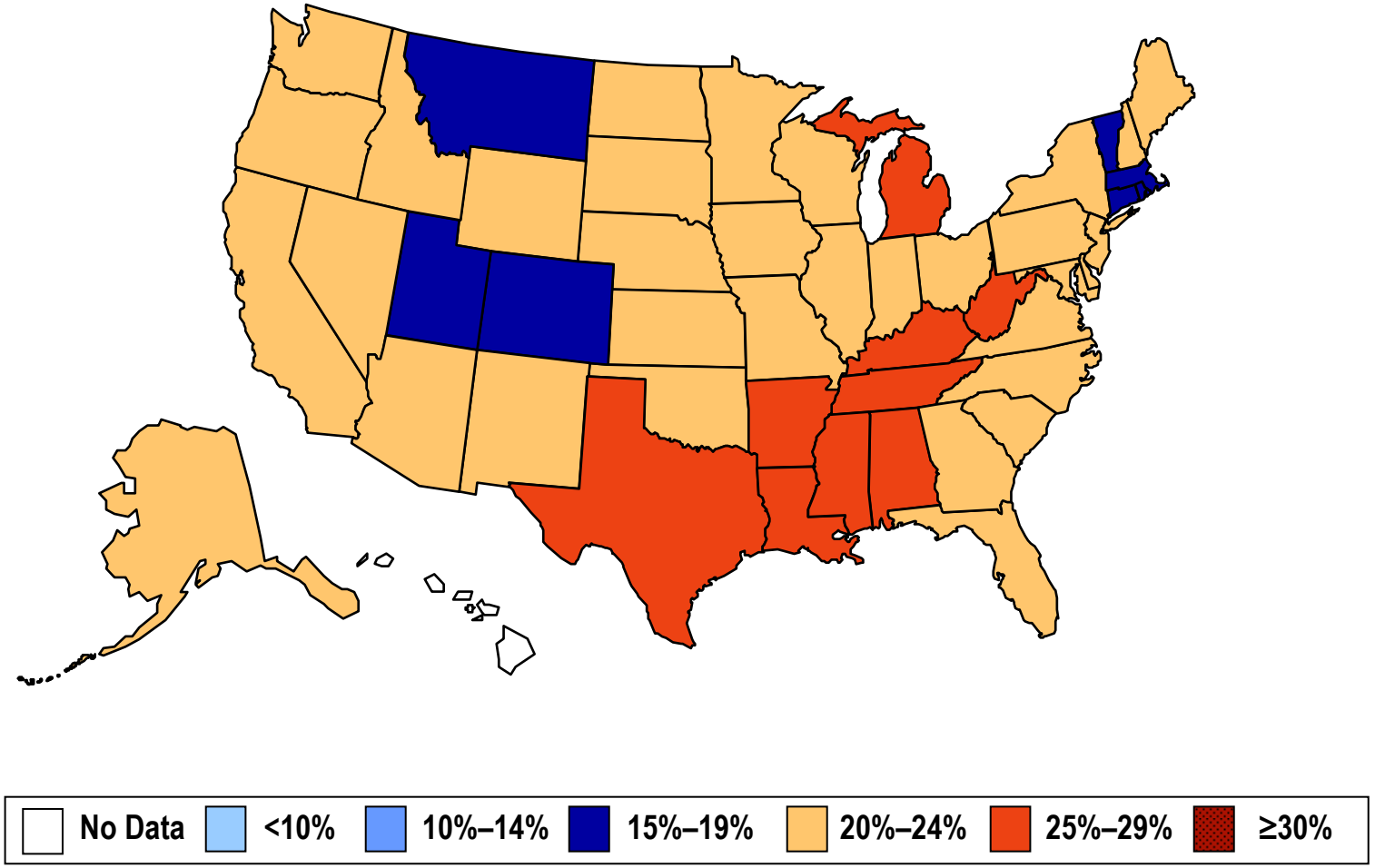

Obesity Trends* Among U.S. Adults BRFSS, 2005

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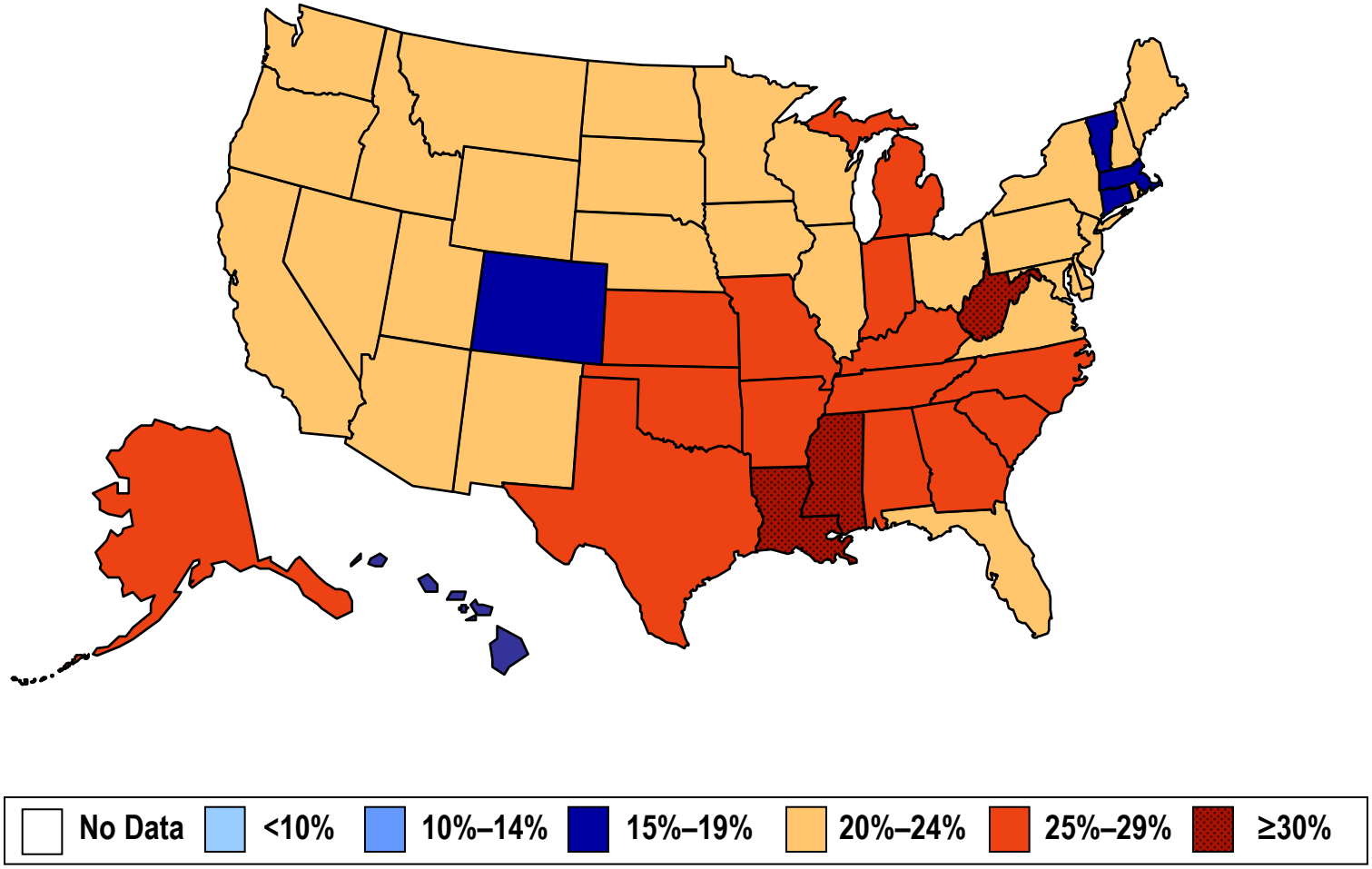

Obesity Trends* Among U.S. Adults BRFSS, 2006

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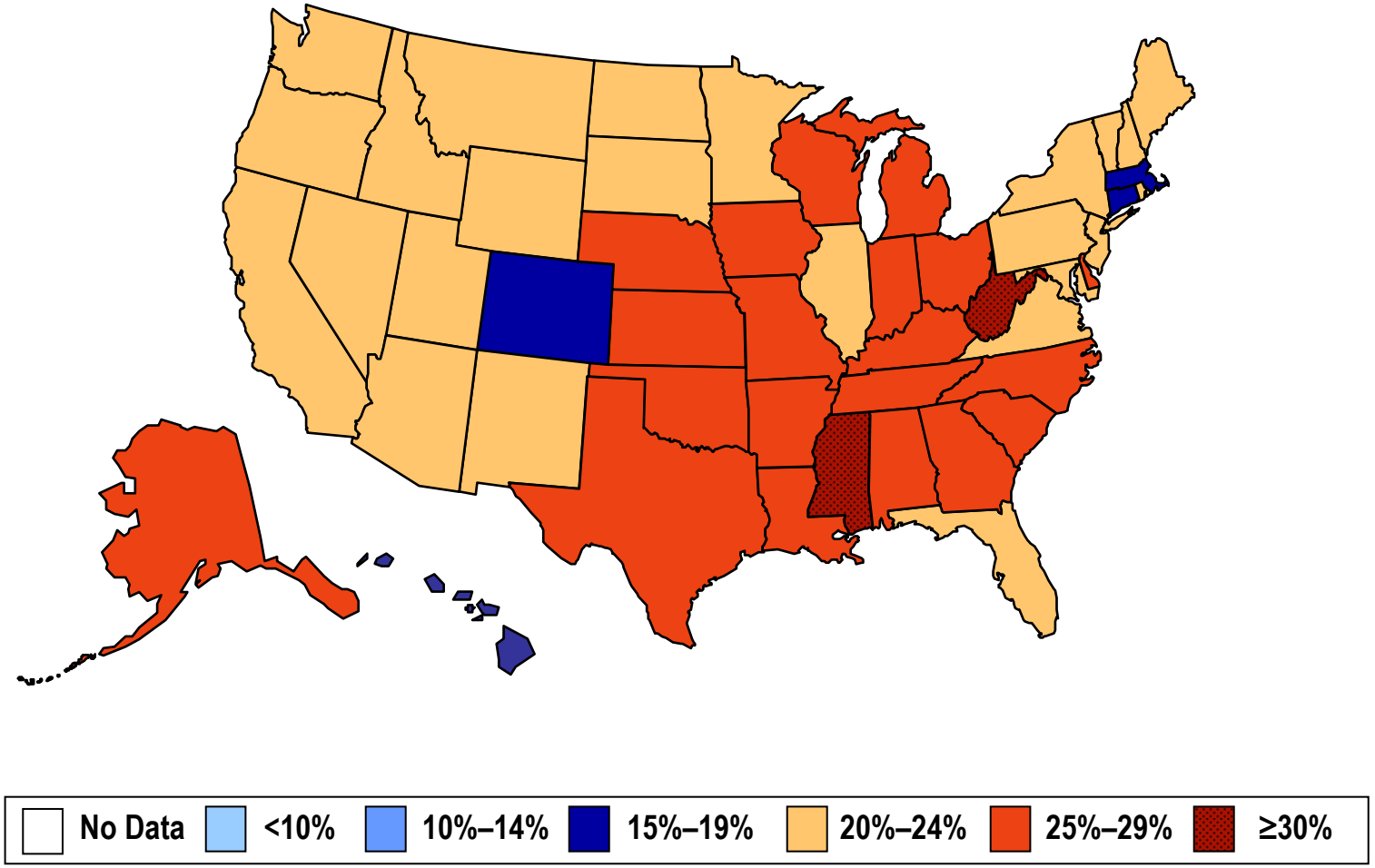
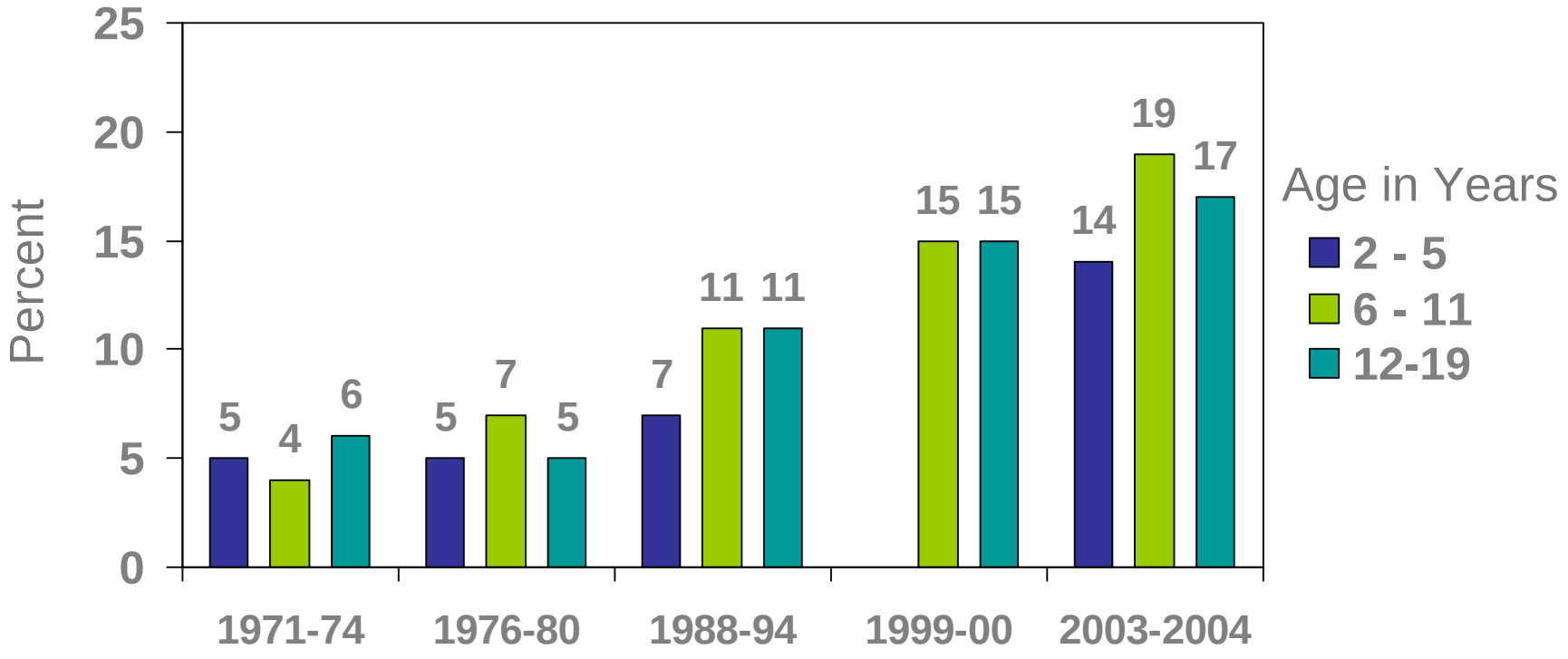


Prevalence of Overweight Among Children & Adolescents



NHANES data; www.cdc.gov

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Prevention

- No studies have looked at pre-diabetes prevention

- The Diabetes Prevention Program asked: "Can diabetes be prevented or delayed in people at high risk for developing diabetes?"

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Diabetes Prevention Program

- 3234 adults with impaired glucose tolerance were divided into three groups:
  - Lifestyle modification
  - Metformin
  - Placebo

Diabetes Prevention Program, NEJM 2002

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Diabetes Prevention Program

Lifestyle modification (1079 people):

- Goals:
  - Achieve and maintain weight loss of ≥ 7%
  - Moderate physical activity for ≥ 150min/wk
- Success rate:
  - Weight: 50% at 24 wks, 38% most recent
  - Exercise: 74% at 24 wks, 58% most recent

Diabetes Prevention Program, NEJM 2002

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Diabetes Prevention Program

Metformin (1073 people):

- Goals:
  - 850mg metformin twice a day
  - Standard lifestyle recommendations
- Success rate:
  - 72% took at least 80% of doses

Diabetes Prevention Program, NEJM 2002

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Diabetes Prevention Program

Placebo (1082 people)

- Goals:
  - Placebo pill twice a day
  - Standard lifestyle recommendations
- Success rate:
  - 77% took at least 80% of doses

Diabetes Prevention Program, NEJM 2002

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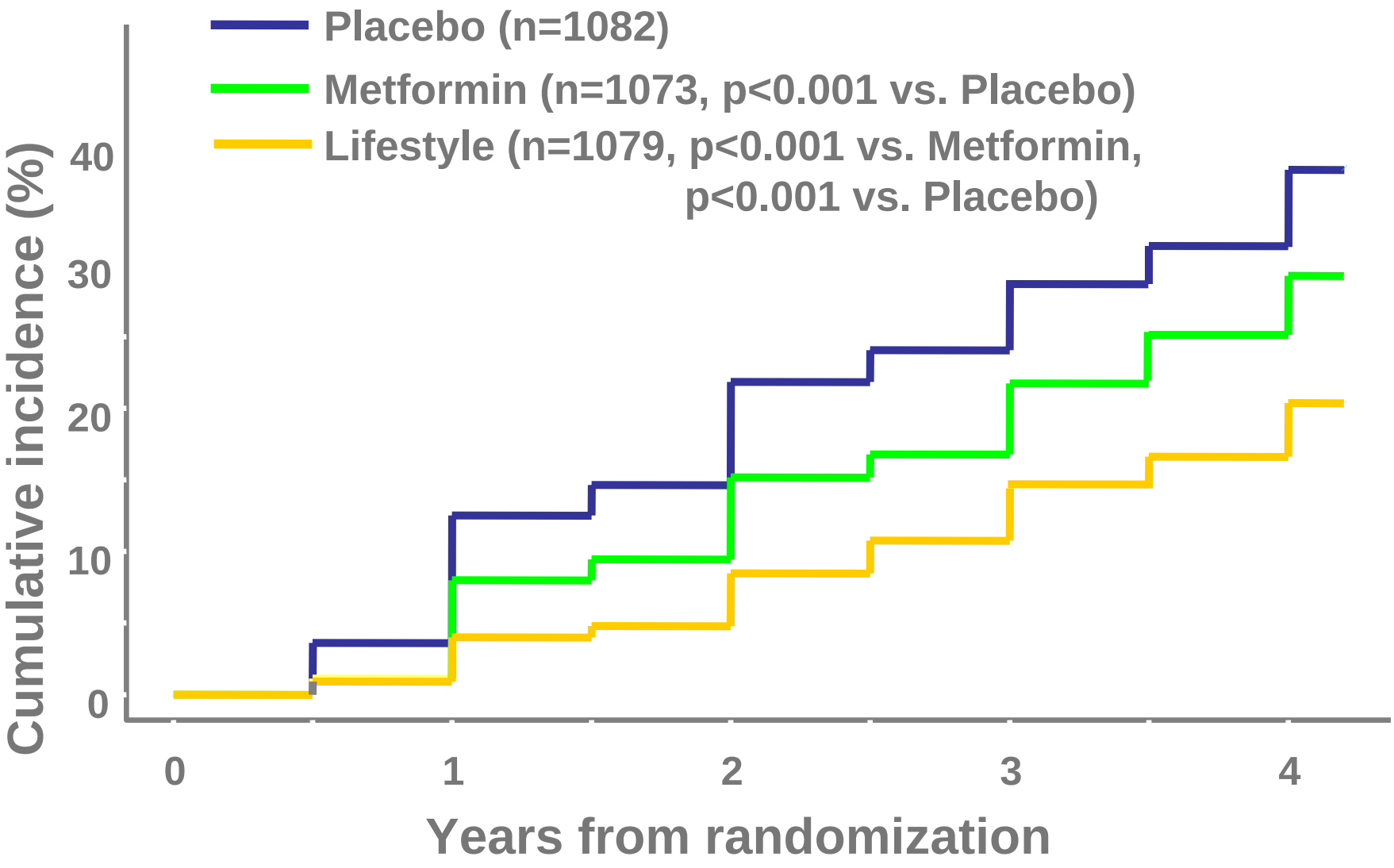
Diabetes Prevention Program

New diabetes diagnoses compared to the placebo group:

- 58% lower in lifestyle modification group
- 31% lower in metformin group

Diabetes Prevention Program, NEJM 2002

Diabetes Prevention Program



Diabetes Prevention Program, NEJM 2002

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Diabetes Prevention Program

Conclusions:

- Type 2 diabetes can be prevented or delayed in people at high risk for diabetes
- Lifestyle modification is more effective than metformin

Diabetes Prevention Program, NEJM 2002

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Strategies for Diabetes Prevention

- Healthy diet
- Regular physical activity
- Avoidance of sedentary activities
- Maintenance of a healthy body weight

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Healthy Diet

- Eat more:
  - Fruits, vegetables, legumes, and whole grains
  - Healthy sources of protein such as fish and poultry
  - Unsaturated vegetable fats
- Eat less:
  - Red and processed meats
  - Refined grains
  - Sugar-sweetened beverages

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Healthy Diet & Weight

- **Eat the appropriate amount of calories to achieve and/or maintain a healthy weight**

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Physical Activity

- Increases cellular sensitivity to insulin
- Helps prevent or delay diabetes onset
- Helps maintain a healthy body weight
- Decreases percent body fat
- Reduces risk of cardiovascular disease
- Improves the lipid profile
- Lowers blood pressure

How Much Exercise Do I Need?

Who	What	How Long	How Often
Healthy adults 18-65 years old	Moderate intensity physical activity	30 minutes	5 days/week
	Vigorous intensity physical activity	20 minutes	3 days/week
Healthy adults 18-65 years old	Activities that maintain or increase muscle strength	8-10 exercises using major muscle groups	2 or more non-consecutive days/week
Adults who want to improve fitness and/or further reduce risks to health	**Exceed** the recommended amounts of physical activity		
Some adults, in order to prevent unhealthy weight gain	**Exceed** minimum recommended amounts of physical activity to a point that is individually effective in achieving energy balance, while considering their food intake and other factors that affect body weight		
To sustain weight loss in adulthood	Moderate intensity physical activity	**60-90 minutes**	**Daily**

American College of Sports Medicine/American Heart Association, 2007

Physical Activity & Exercise

Light (<3.0 METs)	Moderate* (3.0-6.0 METs)	Vigorous§ (>6.0 METs)
▪Walking around home, store, or office = 2.0 ▪Sitting using computer = 1.5 ▪Standing performing light work = 2.0-2.5 ▪Arts & Crafts = 1.5 ▪Darts = 2.5	•Walking 3.0 MPH = 3.3 •Walking very briskly 4.0 MPH = 5.0 •Heavy cleaning = 3.0 •Bicycling, flat, light effort = 6.0 •Golf - walking, pulling clubs = 4.3 •Tennis doubles = 5.0 •Leisurely swimming = 6.0	•Walking 4.5 MPH = 6.3 •Walking upstairs = 8.0 •Hiking moderate pace & grade = 7.0 •Jogging 6.0 MPH = 10.0 •Bicycling moderate effort = 8.0; fast = 10.0 •X-country skiing = 7.0 – 9.0 •Tennis singles = 8.0

*30 minutes at least 5 days/week
§20 minutes at least 3 days/week
MET = Metabolic Equivalent = 1 kcal/kg/hour
Rest = 1 MET

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Sedentary Lifestyle

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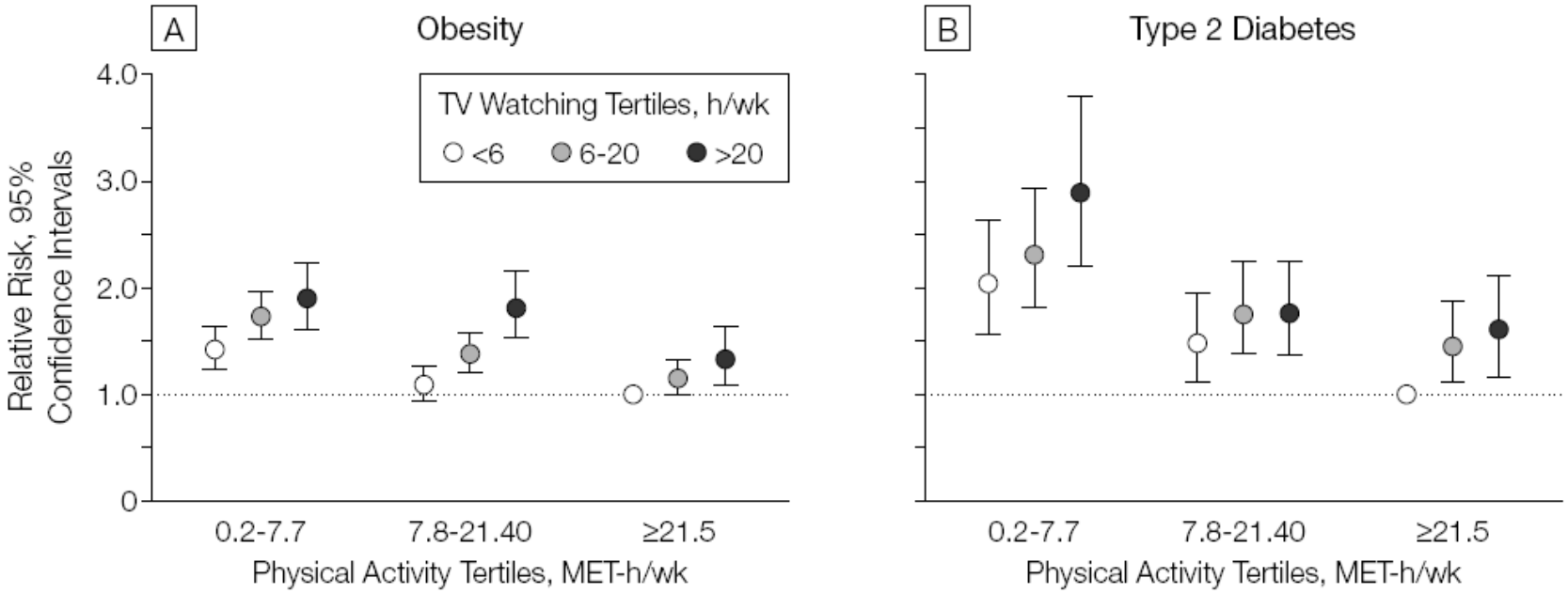
Sedentary Lifestyle & Diabetes Risk



Hu FB et al, JAMA 2003

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T.V. Time & Diabetes

Each 2 hour per day increase in T.V. time is associated with a:

- **23% increase in obesity**
- **14% increase in diabetes**

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Summary

- Diabetes and pre-diabetes are caused by genetic and environmental factors
- Obesity is one of the strongest risk factors for developing pre-diabetes and diabetes
- Diet, exercise, and weight loss can prevent or delay the onset of diabetes in people with pre-diabetes
- Turn off the T.V. and start moving!

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Resources

- Preventive Health
  - Nutrition appointments
  - Fitness assessments & Supervised exercise
  - Exercise classes
- Disease Management Clinic
  - Individual appointments
  - Diabetes Group Class
  - Weight Loss Group Clinic