

# Epidemiology of Obesity

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# Objectives of the lecture

- At the end of the session you should be able to:
- 1-describe the magnitude of the problem of obesity.
- 2-Discuss attributes associated with obesity.
- 3- List the factors leading to obesity.
- 4- Recognize the consequences of obesity.
- 5- Discuss the prevention of obesity.

# Background

Definition and prevalence

# Defining obesity

“Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health.”

- World Health Organization

# Measuring Obesity

## **Primary Screening Measure**

Body Mass Index (BMI) =  $\text{weight}(\text{kg}) / \text{height}(\text{m})^2$

- Calculated from a person's weight and height.
- Reliable indicator of body fatness for most people.
- Inexpensive & easy-to-perform screening for weight categories that may lead to health problems.
- Does not measure body fat directly.

# Defining obesity

## Adults

- BMI  $\geq$  30.0 is obese
- 25.0-29.9 is overweight
- 18.5-24.9 is normal
- $<$  18.5 is underweight

## Children/Adolescents

- Sex/age-specific BMI
- BMI  $\geq$  95<sup>th</sup> percentile is obese
- 85<sup>th</sup> to less than 95<sup>th</sup> percentile is overweight

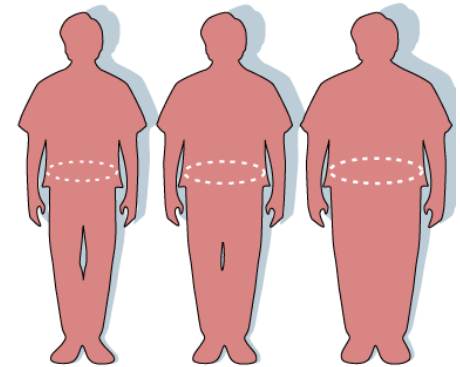
# Defining obesity

## Subdivisions of obesity

- Grade 1 obesity: BMI 30.0-34.9
- Grade 2 obesity: BMI 35.0-39.9
- Grade 3 obesity: BMI 40.0+ (extreme obesity)

# Other ways of estimating obesity

- Look
- Scale
- Waist circumference





# Is obesity a disease or a condition/risk factor?

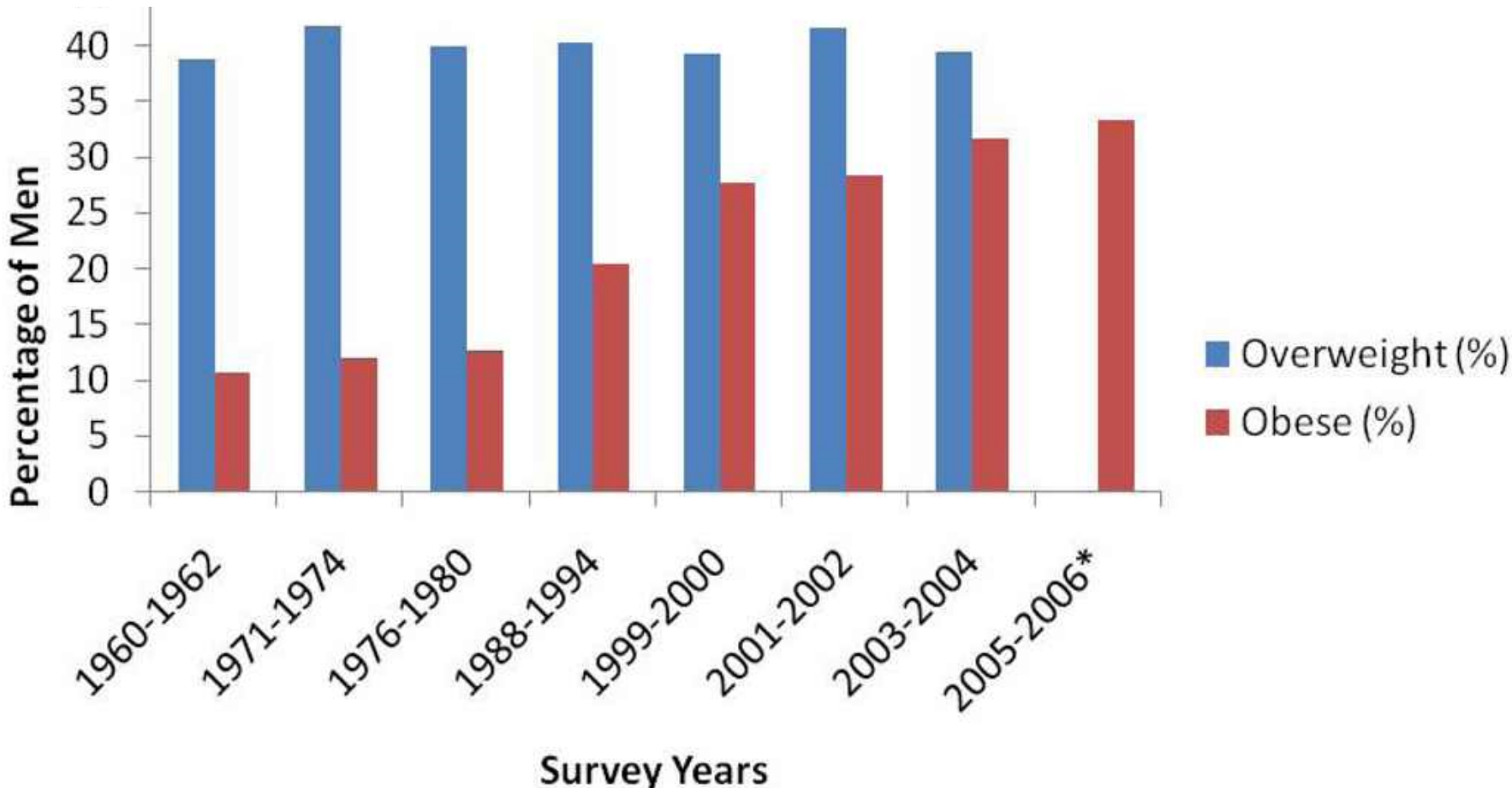
“...recognize obesity as a **disease state** with multiple pathophysiological aspects requiring a range of interventions to advance obesity treatment and prevention.”

– American Medical Association

# Prevalence of obesity globally

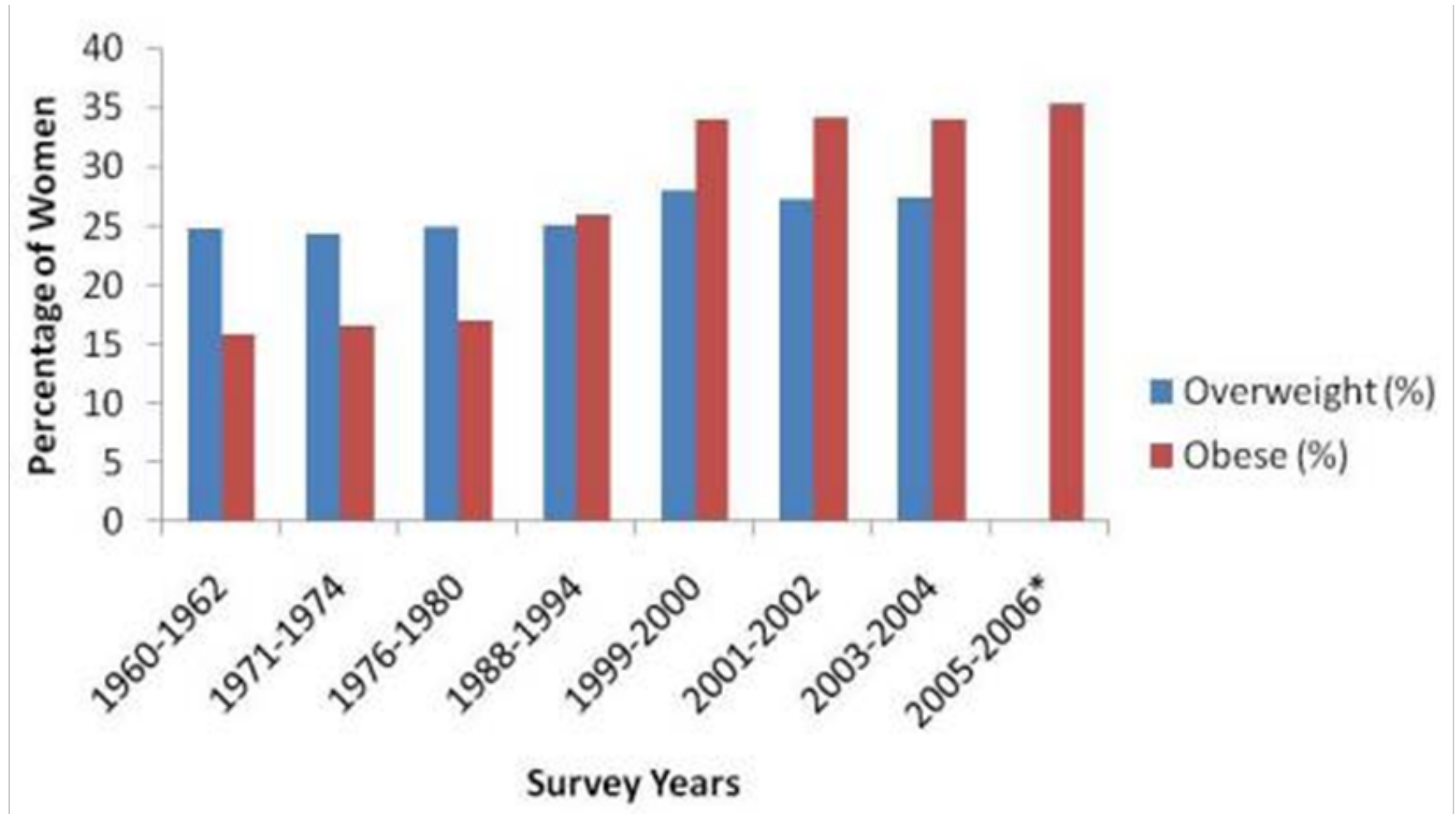
- Obesity worldwide prevalence
- 1995            200 million
- 2000            300 million
- 2008            857 million
- 2013            2.1 billion
  
- 1997 WHO

# Prevalence and Trends of Overweight and Obesity Among men Ages 20–74 Years in the United States: 1960–2006



*\*data not available for overweight for 2006*

# Women Ages 20–74 Years in the United States: 1960–2006



*\*data not available for overweight for 2006*

# Prevalence of obesity in Saudi

Economist.com rankings

## Highest obesity\*

Men, % of total population

1	Lebanon	36.3
2	Qatar	34.6
3	Kuwait	32.8
4	Panama	27.9
5	United States	27.7
6	Cyprus	26.6
7	Saudi Arabia	26.4
8	West Bank and Gaza	23.9
9	Bahrain	23.3
10	Albania	22.8
11	England	22.7
12	Germany	22.5
13	Scotland	22.3
14	Ireland	20.1
15	Israel	19.9
16	Mexico	19.4
17	Australia	19.3
18	United Arab Emirates	17.1
19	Wales	17.0
20	Oman	16.7
21	Slovenia	16.5
	Turkey	16.5
23	Lithuania	16.2
24	Canada	16.0
	Peru	16.0
26	Luxembourg	15.3
27	Sweden	14.8
28	Portugal	14.5
29	Switzerland	14.1
30	Mongolia	13.8

Women, % of total population

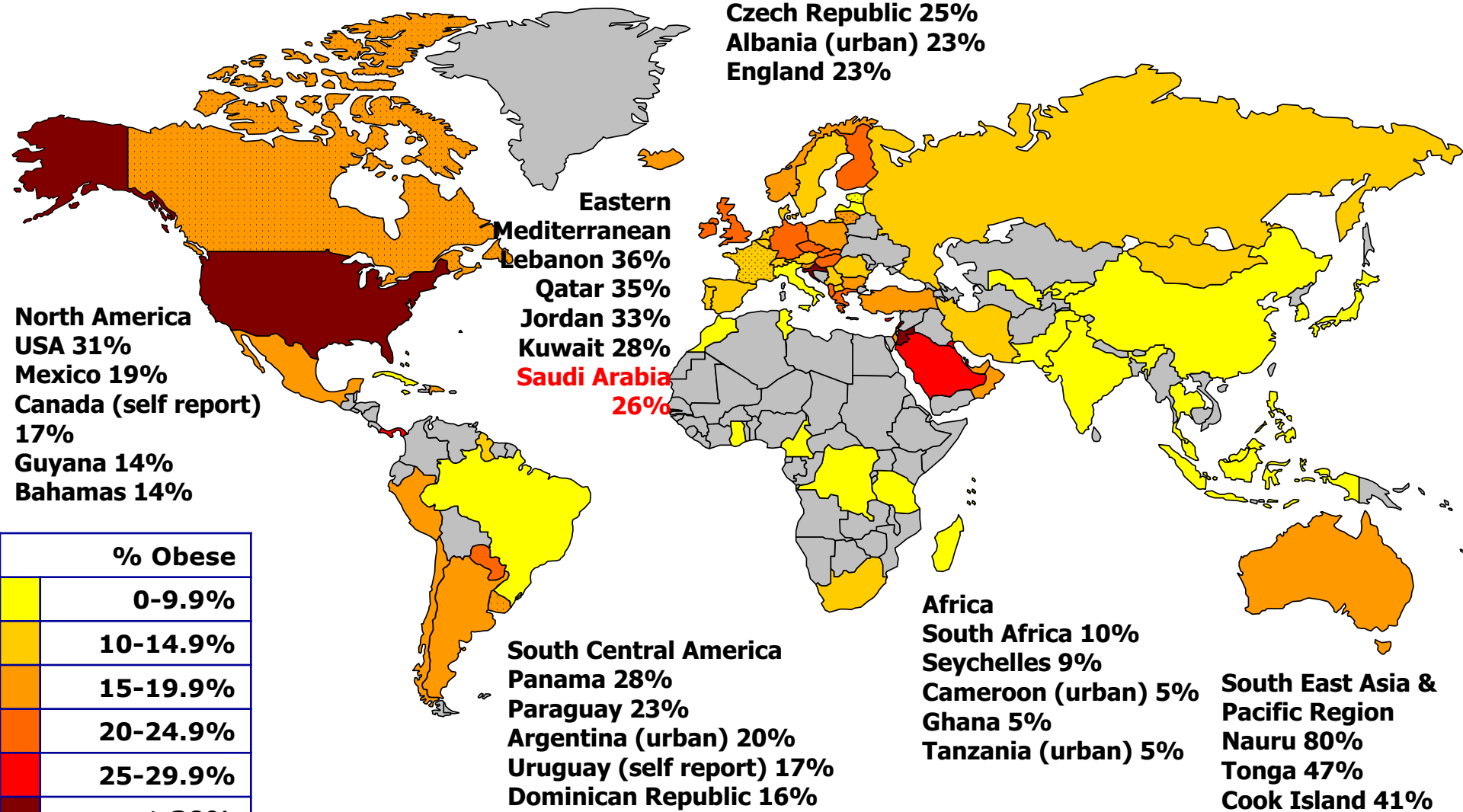
1	Qatar	45.3
2	Saudi Arabia	44.0
3	West Bank and Gaza	42.5
4	Lebanon	38.3
5	Panama	36.1
6	Albania	35.6
7	Bahrain	34.1
8	United States	34.0
9	Egypt	32.4
10	United Arab Emirates	31.4
11	Iran	30.0
12	Kuwait	29.9
13	Turkey	29.4
14	Mexico	29.0
15	Scotland	26.0
16	Israel	25.7
17	Mongolia	24.6
18	Jamaica	23.9
19	England	23.8
20	Cyprus	23.7
21	Germany	23.3
22	Oman	23.1
23	Peru	23.0
24	Australia	22.2
25	Morocco	21.7
26	Russia	21.6
27	Trinidad & Tobago	21.1
28	Fiji	19.3
29	Mauritania	19.2
30	Wales	18.0

\* Data for these health rankings refer to the latest year available, 1999–2003. Obesity is defined as body-mass index of 30 or more

Source: "Pocket World in Figures", based on data from the World Health Organisation

# Global Prevalence of Obesity in Adult Males

With examples of the top 5 Countries in each Region



**European Region**  
 Croatia 31%  
 Cyprus 27%  
 Czech Republic 25%  
 Albania (urban) 23%  
 England 23%

**Eastern Mediterranean**  
 Lebanon 36%  
 Qatar 35%  
 Jordan 33%  
 Kuwait 28%  
**Saudi Arabia 26%**

**North America**  
 USA 31%  
 Mexico 19%  
 Canada (self report) 17%  
 Guyana 14%  
 Bahamas 14%

**South Central America**  
 Panama 28%  
 Paraguay 23%  
 Argentina (urban) 20%  
 Uruguay (self report) 17%  
 Dominican Republic 16%

**Africa**  
 South Africa 10%  
 Seychelles 9%  
 Cameroon (urban) 5%  
 Ghana 5%  
 Tanzania (urban) 5%

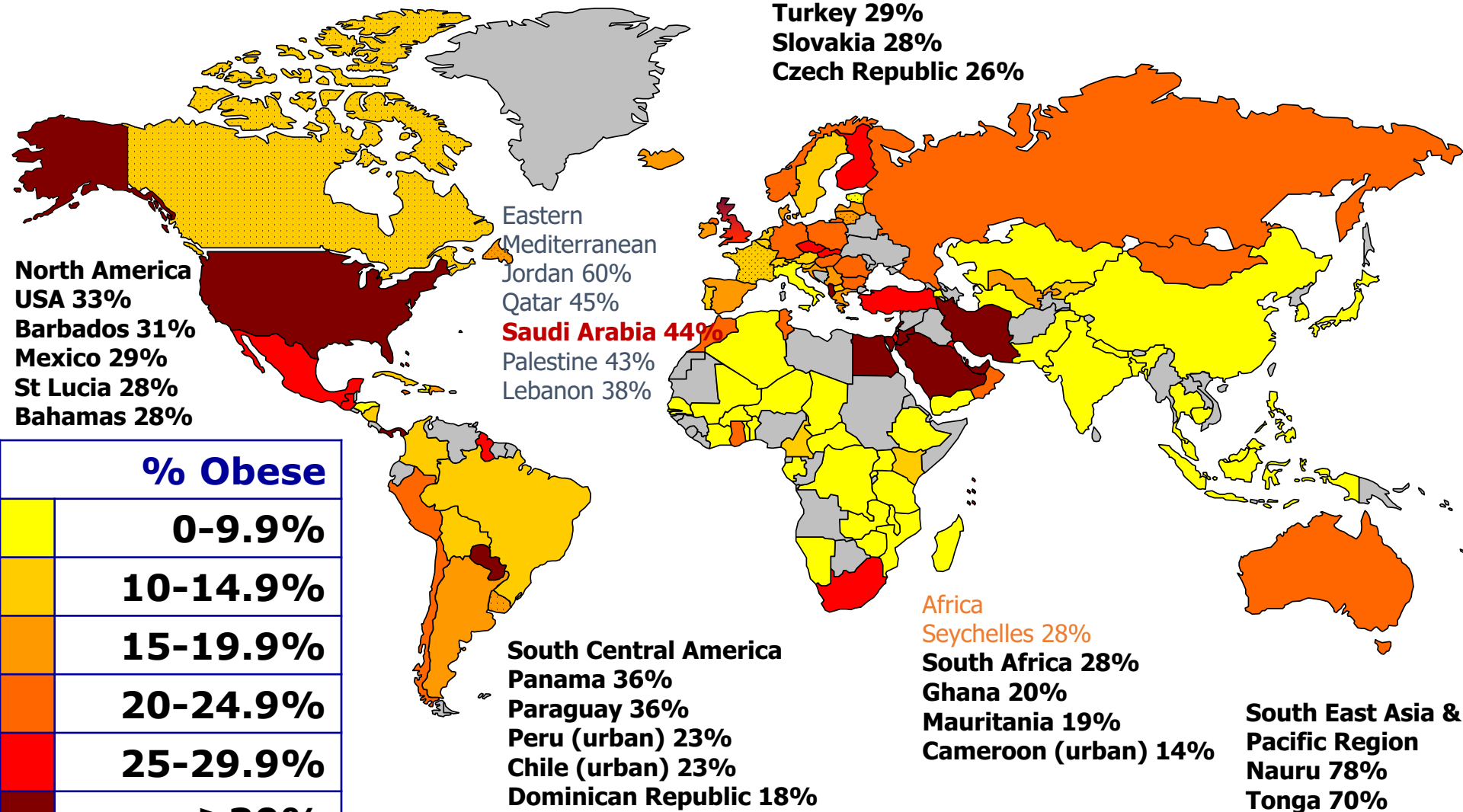
**South East Asia & Pacific Region**  
 Nauru 80%  
 Tonga 47%  
 Cook Island 41%  
 French Polynesia 36%  
 Samoa 33%

% Obese	
	0-9.9%
	10-14.9%
	15-19.9%
	20-24.9%
	25-29.9%
	≥30%
	Self Reported data

With the limited data available, prevalence's are not age standardised. Self reported surveys may underestimate true prevalence. Sources and references are available from the IOTF.  
 © International Obesity TaskForce, London –January 2007

# Global Prevalence of Obesity in Adult Females

With examples of the top 5 Countries in each Region



**European Region**  
**Albania 36%**  
**Malta 35%**  
**Turkey 29%**  
**Slovakia 28%**  
**Czech Republic 26%**

**North America**  
**USA 33%**  
**Barbados 31%**  
**Mexico 29%**  
**St Lucia 28%**  
**Bahamas 28%**

**Eastern Mediterranean**  
**Jordan 60%**  
**Qatar 45%**  
**Saudi Arabia 44%**  
**Palestine 43%**  
**Lebanon 38%**

**South Central America**  
**Panama 36%**  
**Paraguay 36%**  
**Peru (urban) 23%**  
**Chile (urban) 23%**  
**Dominican Republic 18%**

**Africa**  
**Seychelles 28%**  
**South Africa 28%**  
**Ghana 20%**  
**Mauritania 19%**  
**Cameroon (urban) 14%**

**South East Asia & Pacific Region**  
**Nauru 78%**  
**Tonga 70%**  
**Samoa 63%**  
**Niue 46%**  
**French Polynesia 46%**

% Obese	
	0-9.9%
	10-14.9%
	15-19.9%
	20-24.9%
	25-29.9%
	≥30%
	Self Reported data

With the limited data available, prevalence's are not age standardised. Self reported surveys may underestimate true prevalence. Sources and references are available from the IOTF.  
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## Obesity Prevalence % (1992-2022)



M Alqarni SS (2016) A Review of Prevalence of Obesity in Saudi Arabia. J Obes Eat Disord 2:2. doi: 10.21767/2471-8203.100025



# Incidence of obesity

- No official measures of Saudi obesity incidence currently
- Would require accurately identifying the **population at risk** (non-obese) at a given time, as well as **new cases**
- Potential for prospective cohort studies

# Attributes associated with obesity

Who is most affected?

# Race/ethnicity

## **Adults**

- 47.8% non-Hispanic black
- 42.5% Hispanic
- 32.6% non-Hispanic white
- 10.8% non-Hispanic Asian

## **Children/Adolescents**

- 22.4% Hispanic
- 20.2% non-Hispanic black
- 14.1% non-Hispanic white
- 8.6% non-Hispanic Asian

# Race/ethnicity

- The assumption that race reflects only biological distinctions is inaccurate.
- Suggestion from WHO Western Pacific Region that BMI cutoffs may need to be lower for some Asian populations due to increased risk for poor health outcomes

# Age

## **Adults (20+)**

- 39.5% ages 40-59
- 35.4% ages 60+
- 30.3% ages 20-39

## **Children/Adolescents**

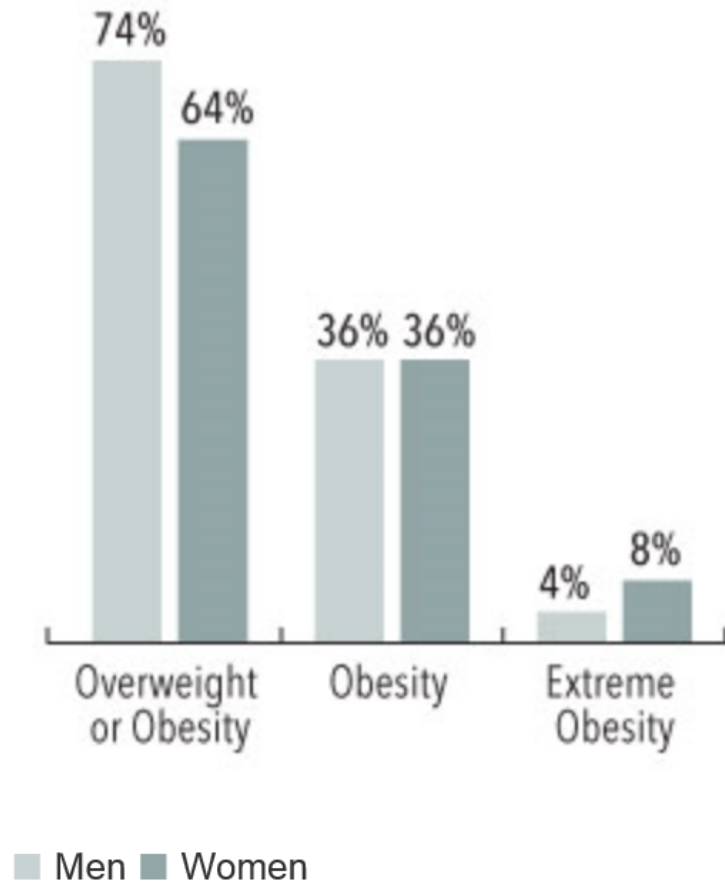
- 20.5% ages 12-19
- 17.7% ages 6-11
- 8.4% ages 2-5\*

*\*down from 13.9% in less than a decade  
(2003/2004 – 2011/2012)*

# Sex

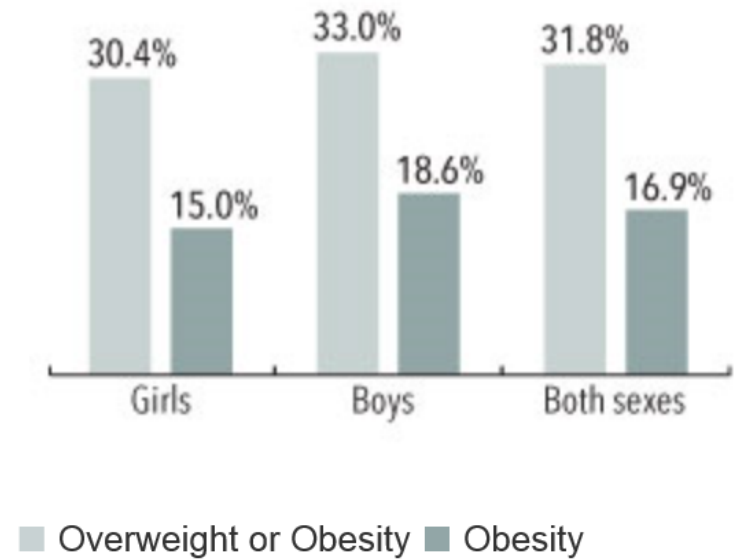
Source: NHANES, 2009–2010

## Estimated Percentage by Sex



Source: NHANES, 2009–2010

## Percentage by Sex, Ages 2–19

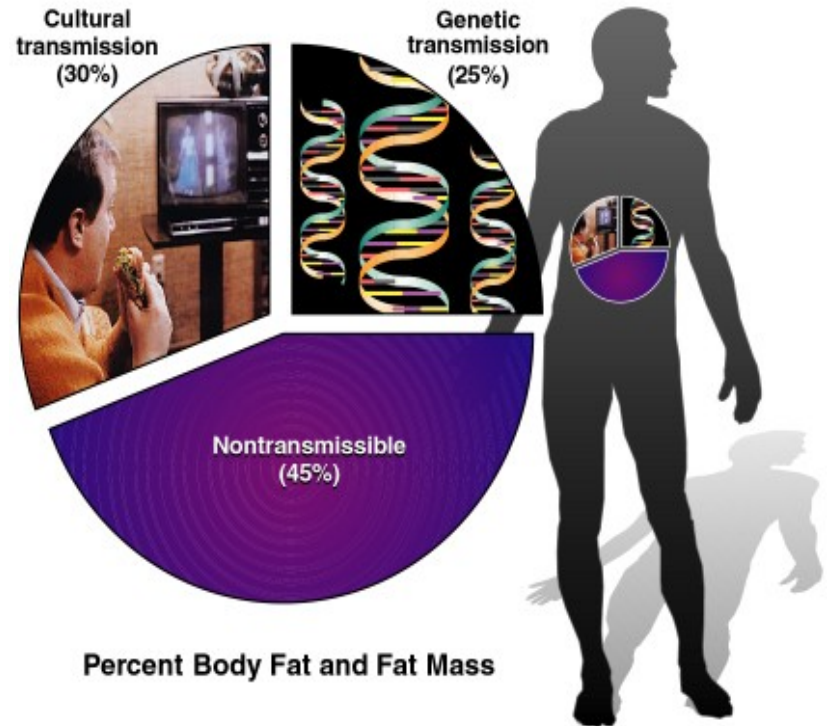


# Genetics

- Family history of obesity
- Other conditions, such as Cushing's disease or polycystic ovary syndrome
- Potential gene variants affecting hunger or metabolism, interacting with environmental influences

- **Genetics plays a role.**
  - How much variation in weight gain among individuals can be accounted for by genetic factors?
  - Largest transmissible variation is cultural.

19.1. Total transmissible variance for body fat.





# Income

- Higher incomes associated with decreased risk of obesity in women, but increased risk in non-Hispanic black men and Mexican-American men
- Being at or below the poverty line is associated with higher rates of obesity among children
- 9 of 10 states with the highest obesity rates are among the poorest

# Education

- Women with college degrees have lower risk of obesity compared to those with less education
- Generally, obesity rates are lower for children if head of household has college degree versus not finishing high school

# Geography & culture

- Higher prevalence of obesity in rural areas
- Risk for obesity among immigrants increases with time spent in the U.S.
- States with highest rates of obesity also have lowest physical activity rates for adults
- Unhealthy food and physical activity environments
- Limited food access, availability, affordability

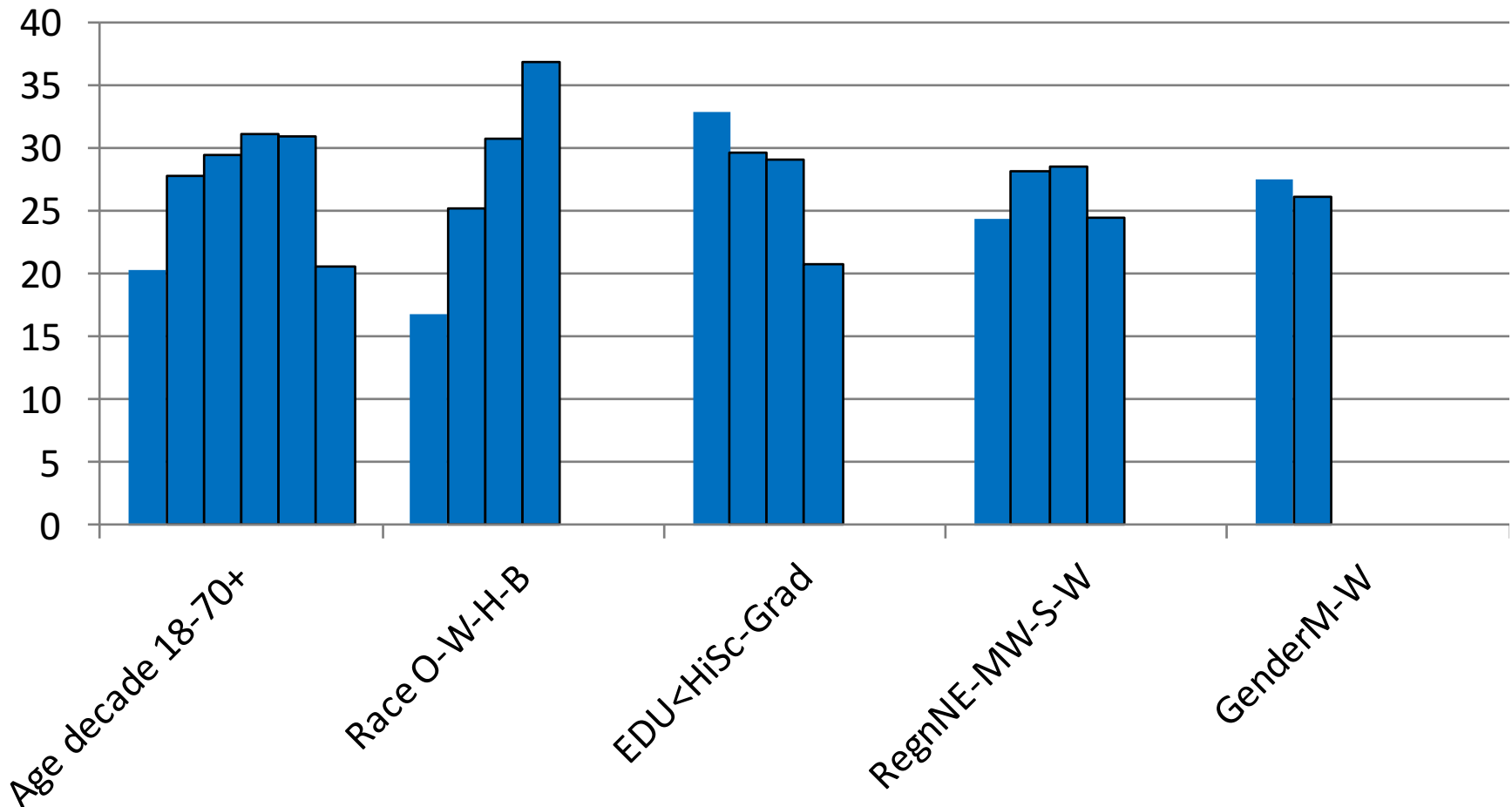
# Adverse behaviors

- Diets high in calories, added sugars, fast food
  - Average daily calorie intake for adults: 2,234
- Low physical activity
  - Only 19% of Americans meet minimum guidelines
  - Saudi Arabia is one of the countries with low physical activity
- Television or other media
  - Sedentary activity
  - Increased exposure to food/beverage marketing
  - Over 7.5 hours daily for older children/adolescents

# Other risk factors

- Maternal smoking
- Extreme birthweight (low or high)
- Not being breastfed
- Disabilities
- Medications (steroids, antidepressants)

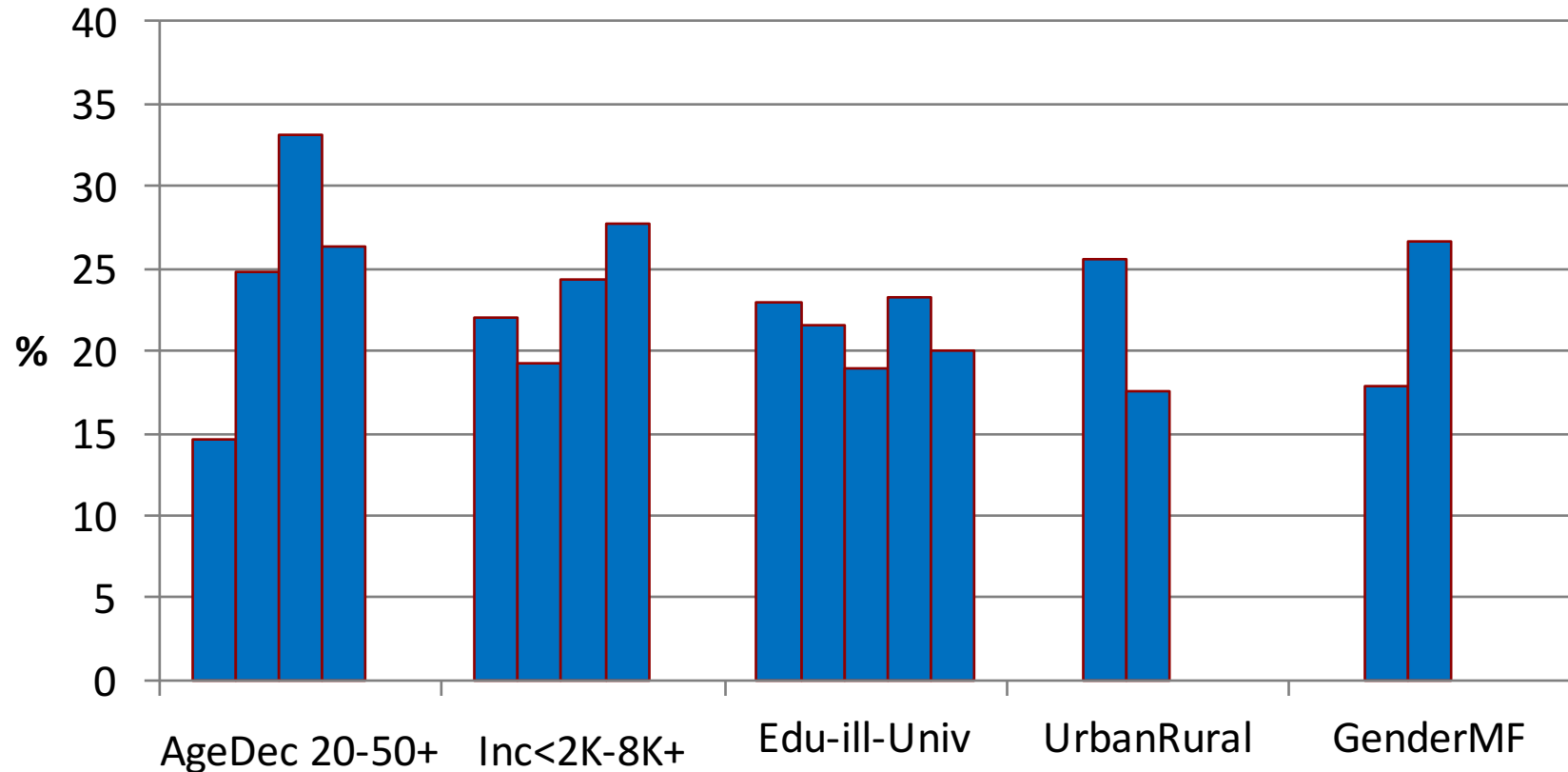
# Demographic Prevalence of Obesity (BMI<sub>≥</sub>30) : USA MMWR August 2010



O=other, W=white, H=Hispanic, B=Blacks

Region: NE=North east, MW=Midwest,  
S=South, W=west

# Demographic Prevalence of Obesity in Saudi Arabia (BMI $\geq$ 30kg/m<sup>2</sup>) 1990-1993



# Morbidity/mortality

Effects on population health



“I would argue that [obesity] is the **most significant public health challenge we face** at this time, both because of the huge number of people it affects and because of the ripple effects it has and will have on the development of debilitating and costly chronic diseases.”

- Daniel R. Glickman, Chair, Institute of Medicine's Committee on Accelerating Progress in Obesity Prevention, 2012

# Morbidity associated with obesity

- **Degree of abdominal fat accumulation is correlated with increased risk of:**
  - Type 2 Diabetes
  - Cardiovascular Disease
  - Stroke
  - Hypertension
  - Nonalcoholic fatty liver disease
  - Osteoarthritis
  - Some cancers

**TABLE 2-1** Physical Health, Psychosocial, and Functional Consequences of Obesity Over the Life Course

Physical Health	Psychosocial	Functional
<ul style="list-style-type: none"> <li>• Cardiovascular disease</li> <li>• Cancer</li> <li>• Glucose intolerance and insulin resistance</li> <li>• Type 2 diabetes</li> <li>• Hypertension</li> <li>• Dyslipidemia</li> <li>• Hepatic steatosis</li> <li>• Choleslitis</li> <li>• Sleep apnea</li> <li>• Reduction of cerebral blood flow</li> <li>• Menstrual abnormalities</li> <li>• Orthopedic problems</li> <li>• Gallbladder disease</li> <li>• Hyperuricemia and gout</li> </ul>	<ul style="list-style-type: none"> <li>• Stigma</li> <li>• Negative stereotyping</li> <li>• Discrimination</li> <li>• Teasing and bullying</li> <li>• Social marginalization</li> <li>• Low self-esteem</li> <li>• Negative body image</li> <li>• Depression</li> </ul>	<ul style="list-style-type: none"> <li>• Unemployment</li> <li>• Mobility limitations</li> <li>• Disability</li> <li>• Low physical fitness</li> <li>• Absenteeism from school or work</li> <li>• Disqualification from active service in the military and fire/police services</li> <li>• Reduced productivity</li> <li>• Reduced academic performance</li> </ul>

SOURCE: Adapted from IOM, 2010a.

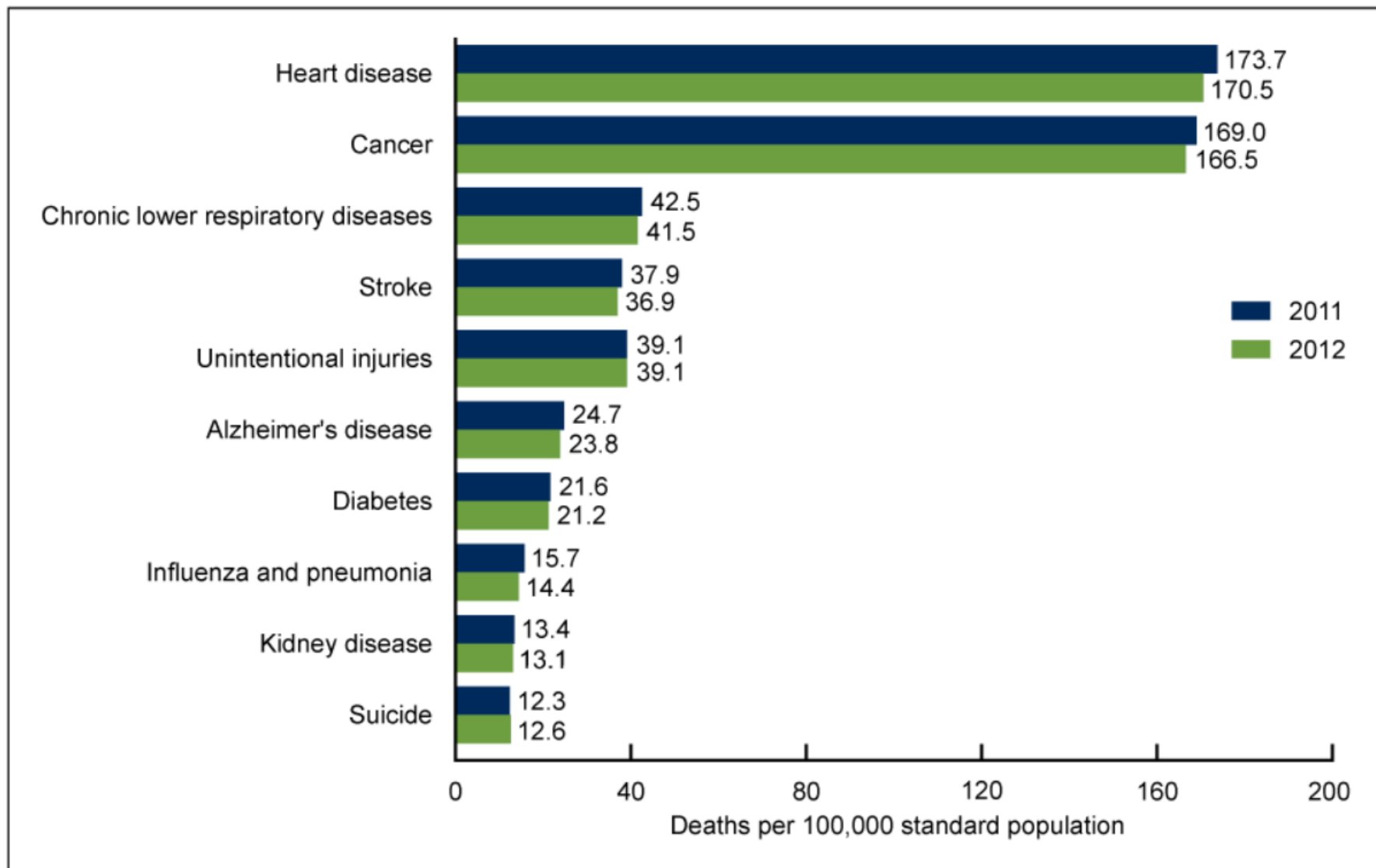
# Morbidity from childhood obesity

- Preschoolers who are overweight or obese are 5 times as likely to be overweight or obese as adults
- Obesity is a **long term** process.
- Obesity frequently begins in childhood.
- **Obese parents** likely have overweight children.
- Regardless of final body weight as adults, overweight children exhibit more illnesses as adults than normal kids.

# Mortality

- More deaths globally associated with obesity/overweight than underweight
  - 2.8 million per year

Figure 3. Age-adjusted death rates for the 10 leading causes of death in 2012: United States, 2011–2012



NOTE: Access data table for Figure 3 at: [http://www.cdc.gov/nchs/data/databriefs/db168\\_table.pdf#1](http://www.cdc.gov/nchs/data/databriefs/db168_table.pdf#1).

SOURCE: CDC/NCHS, National Vital Statistics System, Mortality.

# Screening

Limitations and Recommendations

# Body Mass Index

- BMI was first used in 1835 as a way to estimate the proportion of body fat based on height and weight
- BMI has low sensitivity, especially below 30
- Cannot discern fat vs. muscle content or metabolic risk factors
- Validity?
- At the same BMI, women tend to have more body fat than men.
- At the same BMI, older people, on average, tend to have more body fat than younger adults.
- Highly trained athletes may have a high BMI because of increased muscularity rather than increased body fatness.



# BMI + waist circumference

**TABLE 1. National Heart Lung and Blood Institute Classifications of Overweight and Obesity by BMI and Waist Circumference in Adults<sup>4</sup>**

Classification	BMI (kg/m <sup>2</sup> )	Risk of type 2 diabetes, hypertension, and CVD <i>relative to normal weight and waist circumference*</i>	
		Men ≤ 40 in Women ≤ 35 in	Men ≥ 40 in Women ≥ 35 in
Underweight	< 18.5	---	---
Normal weight	18.5 – 24.9	---	---
Overweight	25.0 – 29.9	Increased	High
Obesity (Class I)	30.0 – 34.9	High	Very High
Obesity (Class II)	35.0 – 39.9	Very High	Very High
Extreme obesity (Class III)	≥ 40	Extremely High	Extremely High

\*NHLBI guidelines note that increased waist circumference can indicate increased disease risk even in individuals considered normal weight.

# Additional limitations

- Self-report of height & weight in surveys

# Costs

Financial impacts on the health care system

# Costs of obesity

- Medical care costs increasing over time due mostly to rise in obesity prevalence
- Socioeconomic costs also related to disability and premature death

# Costs of obesity

\$147 billion in health care costs in 2008  
(10% of all medical spending)

Increases in spending from 1998-2006

- 8.5% (\$34.3 billion) Medicare
- 11.8% (\$27.6 billion) Medicaid
- 12.9% (\$74.6 billion) Commercial insurance

# Interventions

Primary, secondary, tertiary, community-level

# Primary prevention

Preventing obesity **before** it occurs

- Regulating caloric energy balance to prevent problematic weight gain
  - Diet
  - Physical activity
- Environmental factors

# Address barriers to a healthy diet

- Access to healthy food
- Food advertising
- Large portion sizes
- Affordability of healthy food
- Time constraints
- Established behaviors



# Address barriers to physical activity

- Zoning
- Safety
- Areas conducive to physical activity
- Time constraints
- Established behaviors

# Physical activity guidelines

- 2.5 hours per week for adults
- 1 hour per day for children/adolescents
  - Physical activity tends to decline as children get older

# Policy options

- Tax unhealthy foods/beverages
- Calorie labeling in food service facilities
- Food purchasing standards for hospitals/schools

# Secondary prevention

- Recognize overweight or obese individuals early through screening in order to improve outcomes
  - Weight loss interventions
  - Challenges with sustaining weight loss over time
- Reduce risk factors associated with obesity
  - Secondary screening for potential comorbidities
- Need to understand different causes and responses to obesity in order to better target treatments

# Tertiary prevention

- Management of severe obesity to reduce complications
- Bariatric surgery
  - Type 2 diabetes, other comorbidities
- Medications, if shown to be effective

# Community-level interventions

- Incentives for markets to locate to areas with limited food access
- Food and physical activity standards for childcare, schools, and hospitals
- Identifying viable/safe resources for promoting physical activity
- Partnerships for change, including healthy choices and behaviors
- Breastfeeding

# Community-level interventions

## **Obesity Prevention Foundation**

- Educational interventions in schools
- Focus on healthy diet/physical activity choices

# Summary

- Obesity is affected by a complex interaction between the environment, genetic predisposition, & human behavior.
- It has increased risk of numerous chronic diseases, from diabetes and cancers to many digestive diseases.
- The problem of overweight and obesity is one of the most pressing global issue with massive health care cost.
- Demands attention from the healthcare community, researchers, and policy makers.



Questions?