Why Do We Treat Obesity?

Epidemiology
Epidemiology of Obesity

U.S. Epidemic
More than Two Thirds of US Adults Are Overweight or Obese

**NHANES Data**

US Adults Age ≥20 Years

(Crude Estimate)

Population (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>BMI ≥30</th>
<th>BMI 25-29</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962</td>
<td>12.8</td>
<td>30.5</td>
</tr>
<tr>
<td>1974</td>
<td>14.1</td>
<td>32.0</td>
</tr>
<tr>
<td>1980</td>
<td>14.5</td>
<td>31.5</td>
</tr>
<tr>
<td>1994</td>
<td>22.5</td>
<td>32.0</td>
</tr>
<tr>
<td>2000</td>
<td>30.5</td>
<td>34.0</td>
</tr>
<tr>
<td>2008</td>
<td>33.9</td>
<td>34.4</td>
</tr>
<tr>
<td>2010</td>
<td>35.9</td>
<td>33.3</td>
</tr>
<tr>
<td>2012</td>
<td>35.1</td>
<td>33.9</td>
</tr>
</tbody>
</table>

1.7-fold increase in obesity since 1962

BMI = body mass index (in kg/m²); NHANES = National Health and Nutrition Examination Survey (x-axis lists last year of each survey).

Obesity Rates Are Increasing Across the United States

BFRSS Data

Adults with BMI ≥30 kg/m²
- No data
- <10%
- 10%–14%
- 15%–19%
- 20%–24%
- 25%–29%
- ≥30% (2010)
- 30%–34% (2011-2013)
- ≥35%

*BFRSS methodology changed in 2011 and data from 2010 and earlier cannot be compared to data from 2011 onward.

BRFSS = Behavioral Risk Factor Surveillance System; BMI = body mass index.

Prevalence of Obesity Varies With Race, Ethnicity, and Sex

NHANES Data
US Adults Age ≥20 Years With BMI ≥30

BMI = body mass index (in kg/m²); NHANES = National Health and Nutrition Examination Survey (x-axis lists last year of each survey).
Epidemiology of Obesity

Worldwide Trends
Worldwide Prevalence of Obesity 2015

Women, Age ≥18 Years

Men, Age ≥18 Years

WHO. Global Health Observatory Map Gallery. Available at: http://gamapserver.who.int/mapLibrary/app/searchResults.aspx.
Obesity Increase Is Associated with Rising Rates of Diabetes Worldwide

Current estimated prevalence: 415 million worldwide
By 2040, 642 million people worldwide are expected to have diabetes

Strong Association Between Weight Gain and Diabetes: Rural India

**Obesity***

- 1989: 2.0%
- 2003: 17.1%

750% increase

**Diabetes**

- 1989: 2.2%
- 2003: 6.4%

191% increase

*BMI ≥25 kg/m².

BMI = body mass index.

The Increase in Diabetes Parallels the Increase in Obesity in the United States

**Obesity**

- 1998: 17.9%
- 2012: 35.1%
- 96% increase

**Diabetes**

- 1998: 6.5%
- 2014: 9.3%
- 43% increase

*BMI ≥30 kg/m².

BMI = body mass index.

Epidemiology of Obesity

Impact on Clinical Outcomes
Increased abdominal adiposity is highly correlated with insulin resistance and type 2 diabetes.

BMI = body mass index.

Prevalence of Weight-Related Comorbidities in the US

NHANES 2007-2010
US Adults Age ≥18 Years (N=12,175)

Normal weight = BMI 18 to <25 kg/m²; overweight = BMI 25 to <30 kg/m²; obese = BMI ≥30 kg/m²

BMI = body mass index; DM = diabetes mellitus; DBP = diastolic blood pressure; HDL-C = high density lipoprotein cholesterol; HT = hypertension; SBP = systolic blood pressure.

Mortality Increases with BMI

Cancer Prevention Study II
(N=1,046,154)

<table>
<thead>
<tr>
<th>BMI Category</th>
<th>CVD Death Risk</th>
<th>Cancer Death Risk</th>
<th>Other Causes Death Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Overweight</td>
<td>1.4</td>
<td>1.8</td>
<td>2.2</td>
</tr>
<tr>
<td>Obese</td>
<td>1.8</td>
<td>2.6</td>
<td>3.0</td>
</tr>
</tbody>
</table>

CVD death risk significantly increased for both men and women with increasing BMI.

*Cox proportional hazards model adjusted for age at enrollment, education, physical activity, alcohol use, marital status, aspirin use, fat consumption, vegetable consumption, and use estrogen replacement therapy in women.

All-Cause Mortality Increases with BMI

National Institutes of Health AARP Cohort Study, 1996-2009
(N=109,947 Never-Smokers)

Multivariate hazard ratio* for body mass index (kg/m²)

**Men**
- <18.5: 1.28
- 18.5-22.4 (Referent): 1
- 22.5-24.9: 1.02
- 25.0-27.4: 1.25
- 27.5-29.9: 1.46
- ≥30.0: 1.7

**Women**
- <18.5: 1.2
- 18.5-22.4 (Referent): 1
- 22.5-24.9: 1.15
- 25.0-27.4: 1.7
- 27.5-29.9: 2.13
- ≥30.0: 2.43

*P<0.0005 for linear trend

*Regression analyses adjusted for age, race/ethnicity, education, leisure-time physical activity, and alcohol consumption.

Earlier Weight Gain Increases Total Mortality Risk

National Institutes of Health AARP Cohort Study, 1996-2009
(N=109,947 Never-Smokers)

<table>
<thead>
<tr>
<th>Study entry (Age 50-71)</th>
<th>Age at which BMI ≥25 kg/m²</th>
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</thead>
<tbody>
<tr>
<td>0.98</td>
<td>1.12</td>
</tr>
<tr>
<td>0.96</td>
<td>1.26</td>
</tr>
<tr>
<td>1.12</td>
<td>1.32</td>
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<tr>
<td>1.26</td>
<td>1.68</td>
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<td>1.32</td>
<td>1.68</td>
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<td>1.68</td>
<td>2.04</td>
</tr>
<tr>
<td>2.04</td>
<td></td>
</tr>
</tbody>
</table>

Multivariate hazard ratio*

*Regression analyses adjusted for age, race/ethnicity, education, leisure-time physical activity, and alcohol consumption.

Racial Differences in BMI-Mortality Association

National Health Interview Survey, 1997-2006

All-Cause Mortality Rates Among Individuals Who Have Never Smoked

Deaths per 1000 person-years

Body mass index (kg/m²)

Age-standardized all-cause mortality rates for persons aged 35-75 years without a history of heart disease or cancer at baseline.

Epidemiology of Obesity

Economic Impact
The Effect of Weight on Healthcare Costs

Obesity-Related Illness Accounts for One-Fifth of U.S. Healthcare Costs

Obesity Costs\(^1\)
U.S. Adults Age ≥18 Years

<table>
<thead>
<tr>
<th>Health Expenditures (2005 US$, billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
</tr>
<tr>
<td>$923.2 billion</td>
</tr>
</tbody>
</table>

- **Obesity** $190.2 billion
  - 20.6% of total costs

Diabetes Costs\(^2\)
U.S. Residents, All Ages

<table>
<thead>
<tr>
<th>Health Expenditures (2007 US$, billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
</tr>
<tr>
<td>$1,300 billion</td>
</tr>
</tbody>
</table>

- **Diabetes** $176 billion
  - 13.5% of total costs

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Medicare Spending Is Rising Significantly Faster in the Overweight Population

**Annual Increase in Medicare Expenditures 1997-2006**

- Normal weight: $122 (P=0.01)
- Overweight: $230 (P=0.001)
- Obese: $271

After adjustment for obesity-related chronic conditions, interactions were no longer significant

Obesity Significantly Increases Medicare Expenditures

Mean Expenditures in 2003
Individuals >65 Years of Age

*Includes dental and other costs not shown. **P≤0.001 vs normal weight.

BMI = body mass index in kg/m².

Weight Loss Reduces Lifetime Healthcare Costs

Projected Lifetime Healthcare Expenditures
Obese Individuals <45 Years of Age

- 5% Weight Loss for 2 Years
  Total Benefit $334
- Permanent 5% Weight Loss
  Total Benefit $3150
- Permanent 10% Weight Loss
  Total Benefit $6400

Cost offsets
- Prolonged life
- Improved health

Summary

- Obesity is increasing globally
  - Rates of obesity have risen dramatically in the United States over the past 4 decades
  - The increase in obesity is strongly associated with the increase in diabetes in the U.S. and worldwide
- Obesity is costly