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Obesity and Mortality

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Agenda

- Obesity – where are we now
- Mortality – how bad is it and a paradox
- Health – it can get worse
- What can be done – it won't be easy



Obesity Where are we now



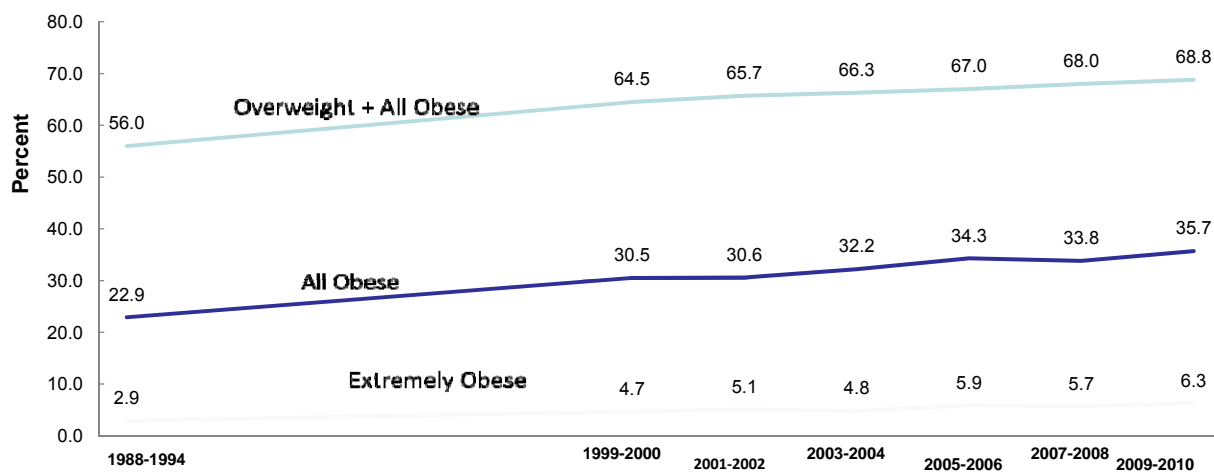
Status

- Obesity prevalence in the U.S. has grown in spurts
 - Current spurt in the U.S. between 1975 and 2005
 - Worldwide, the speed and progression has varied by country and population segment
 - Reflects stage of economic development, culture and local conditions
- Prevalence of adult overweight (BMI: 25 and 30) and class I obese (BMI: 30 and 35) appears to be stabilizing
 - Increase in the morbidly obese continues
 - A few bright signs, but too early to declare victory
 - Children in several large U.S. cities in the last few years
 - NHANES 2011-12 slightly lower for males than 2009-10



Past 30 years – U.S. adults

Trends in overweight, obesity, and extreme obesity among adults aged 20 and over United States , 1988-2010

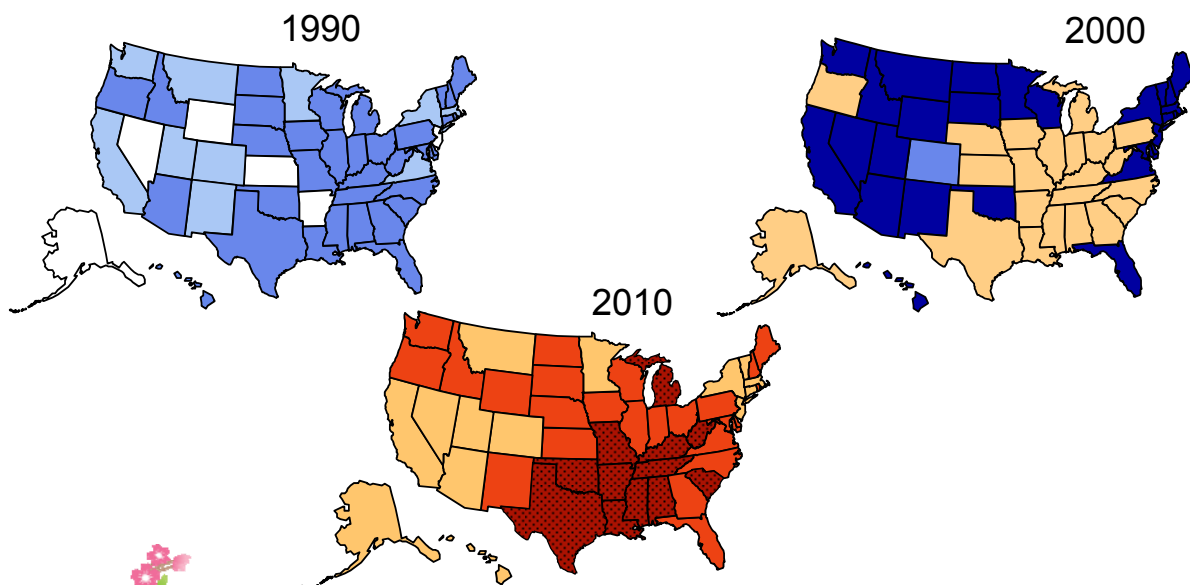


- Rate of growth larger for the extremely obese
- 2011-12 All Obese reported at 34.9%



Obesity of U.S. adults

Behavioral Risk Factor Surveillance System – self-reported BMIs



No Data

<10%

10%–14%

15%–19%

20%–24%

25%–29%

≥30%

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Obesity prevalence in the last decade

Ages	Males				Females			
	All	White (non-H)	Black (non-H)	Mexican American	All	White (non-H)	Black (non-H)	Mexican American
2009-2010								
20-39	33.2%	34.5%	35.8%	32.7%	31.9%	26.9%	56.2%	37.8%
40-59	37.2	37.4	42.6	38.1	36.0	31.8	62.7	53.9
60 +	36.6	37.1	37.8	40.7	42.3	41.8	55.5	42.5
Total	35.5	36.2	38.8	36.6	35.8	32.2	58.5	44.9
1999-2000								
20-39	23.7	22.0	27.4	30.4	28.4	24.4	46.2	30.6
40-59	28.8	28.5	29.9	27.0	37.8	34.2	53.2	48.5
60 +	31.8	34.3	26.4	29.7	35.0	33.3	50.2	41.0
Total	27.8	27.3	28.1	28.9	33.4	30.1	49.7	39.7

- Increase greater for males, although 2011-2012 males are at 33.5% and females at 36.1%

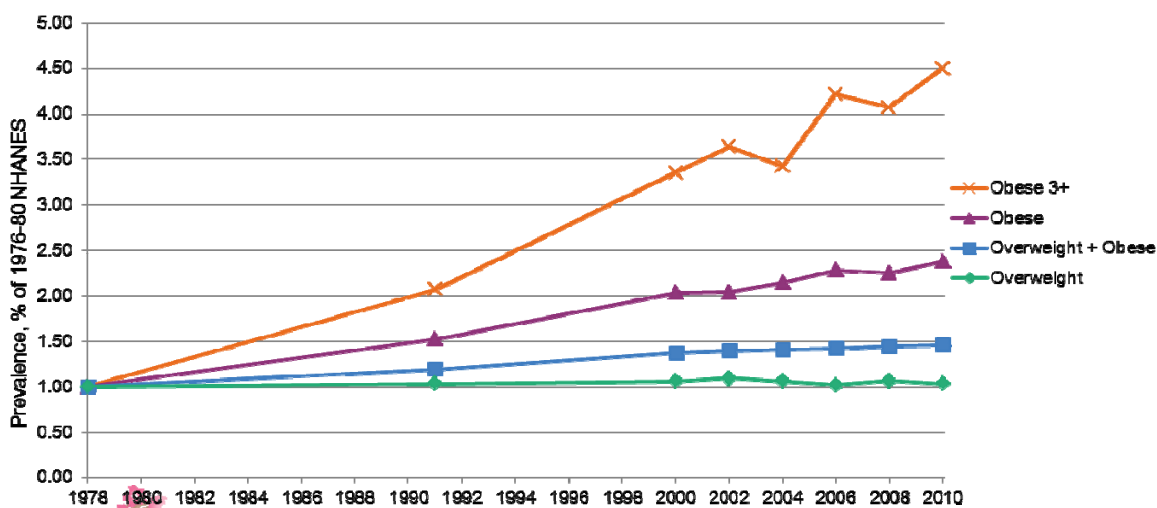


2009-2010 Obesity subgroups

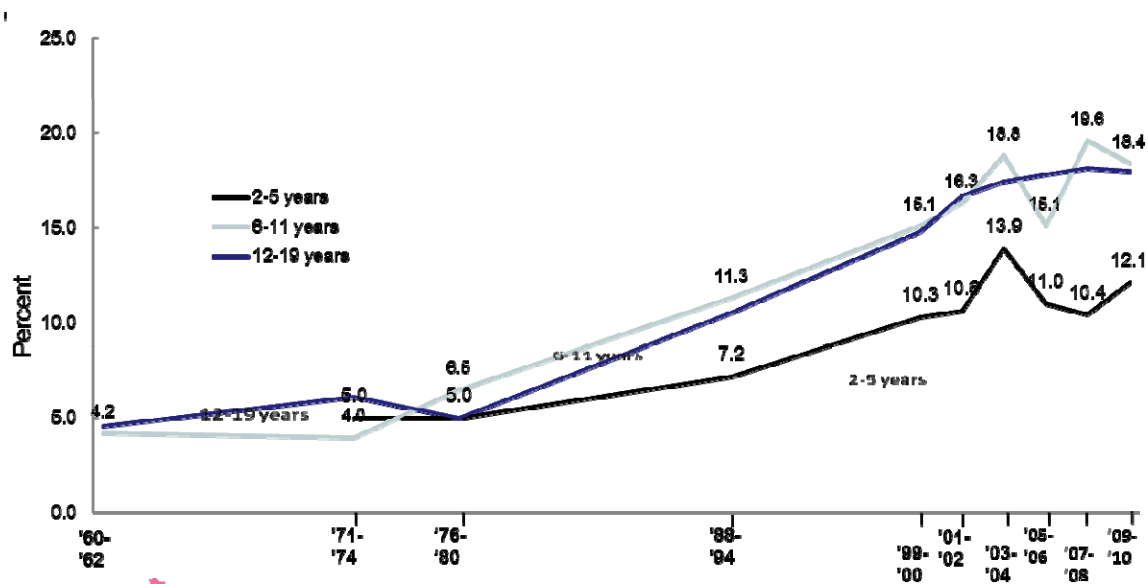
Ages	Males					Females				
	All	White (non-H)	Black (non-H)	Hispanic	Asian (non-H)	All	White (non-H)	Black (non-H)	Hispanic	Asian (non-H)
All obese										
20-39	29.0%	24.6%	34.9%	42.0%	12.0%	31.8%	27.8%	55.8%	35.8%	10.9%
40-59	39.4	41.1	38.2	39.9	11.0	39.5	36.3	58.6	51.9	11.8
60 +	32.0	31.8	39.2	37.3	4.9	38.1	35.9	54.8	47.1	11.9
Total	33.5	32.4	37.1	40.1	10.0	36.1	32.8	56.6	44.4	11.4
Class 2+ obese										
20-39	11.9	10.0	18.0	14.9	3.8	15.4	13.7	30.6	15.1	1.1
40-59	12.2	12.8	15.7	8.7	0.0	19.1	16.9	30.4	25.5	4.6
60 +	11.2	10.9	12.8	11.9	0.8	16.3	15.5	25.0	20.5	3.6
Total	11.9	11.2	15.9	11.9	1.7	17.0	15.3	29.2	20.2	3.0
Class 3+ obese										
20-39	3.5	2.6	5.6	5.4	0.6	7.7	6.8	17.5	5.8	1.1
40-59	5.4	5.2	8.9	2.9	0.0	9.8	8.8	17.9	9.1	1.9
60 +	4.1	3.6	5.7	2.2	0.0	6.8	6.2	12.1	8.2	1.0
Total	4.4	3.8	6.9	3.7	0.2	8.3	7.4	16.4	7.6	3.7



Overweight and obesity class trends



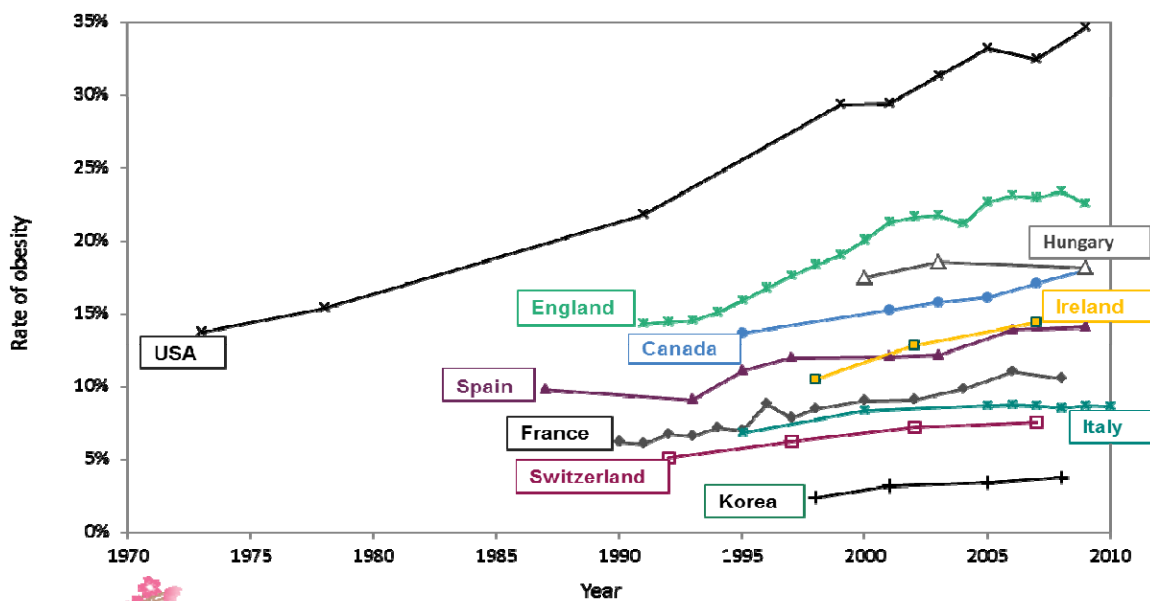
Obesity youth trends



Source: NHANES



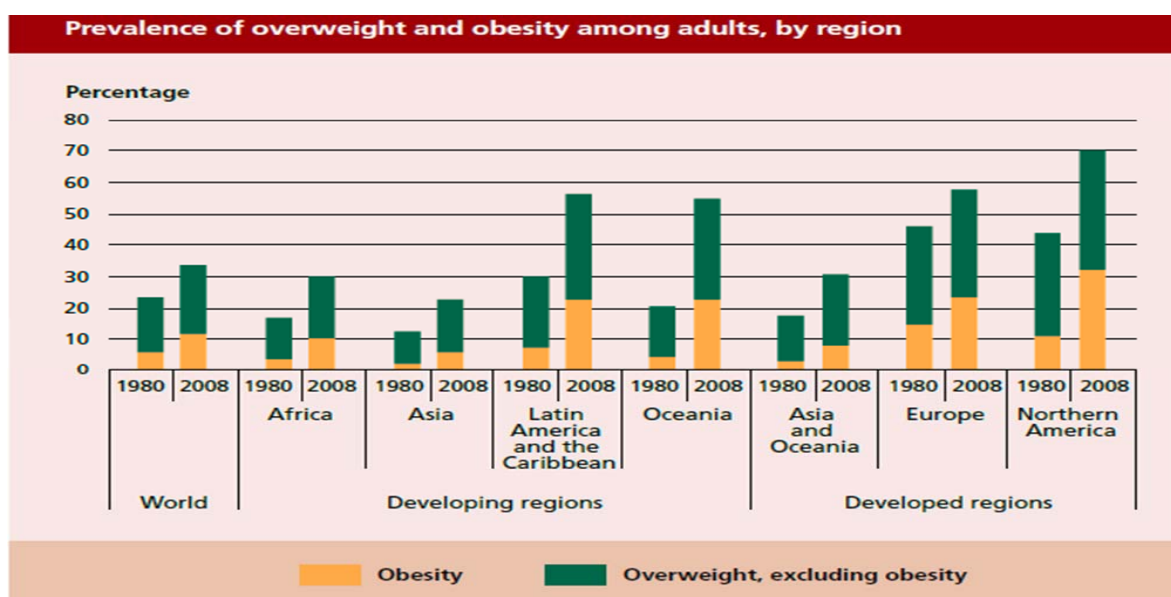
Worldwide obesity



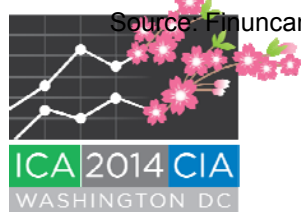
Source: 2010 OECD



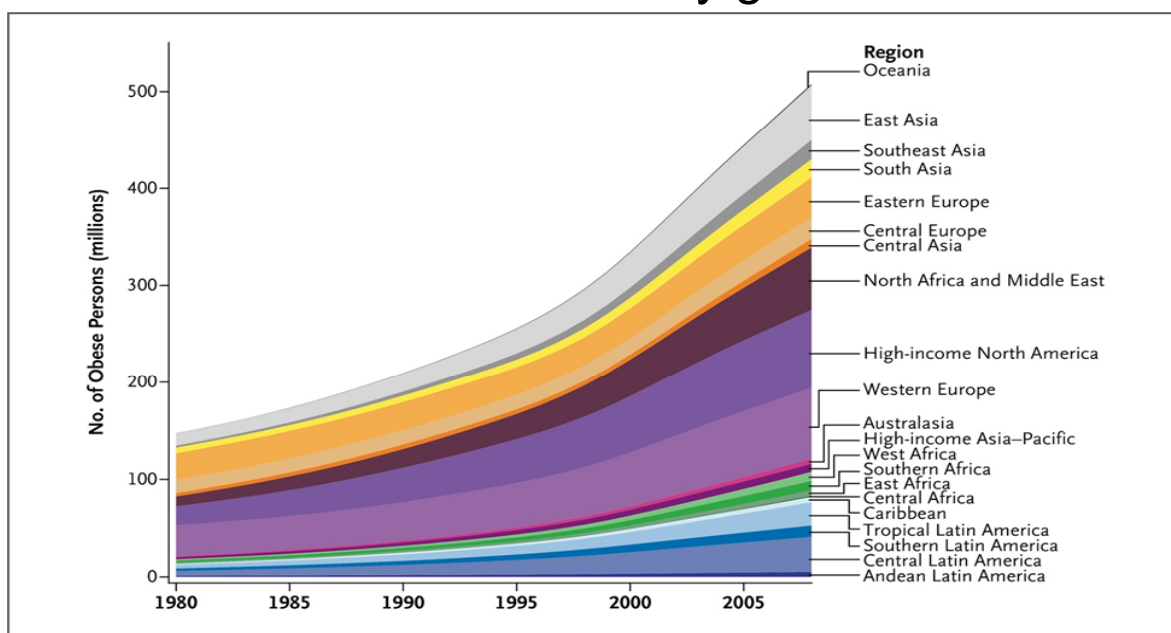
Worldwide obesity – by region



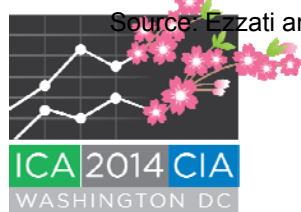
Source: Finucane et al (2011), Stevens et al (2012)



Worldwide obesity growth



Source: Ezzati and Riboli (2013)



Mexico / U.S. comparison

- In June – according to a U.N. study, Mexico surpassed the U.S. in level of (self-measured) obesity
- Higher probability of experiencing chronic conditions (e.g. cardiovascular conditions) in the U.S.
- But given occurrence of a condition, Mexicans have experienced higher mortality
 - Elderly in the U.S. only experience excess mortality at higher level of obesity (highest quantile), while in Mexico experience excess mortality in top two quantiles#

Monteverde et al “Obesity and Excess Mortality Among the Elderly in the United States and Mexico” February 2010 *Demography* speculates this could be due to better reporting of self-reported conditions, reduction in mortality from these conditions and better treatment in the U.S.



How did the U.S. get here

- Nutrition
 - Western-style eating habits[#]
 - More fast food and low-quality snacks
 - Excessively large serving sizes
 - Relative price for fresh food has increased relative to those of processed food
 - Dual worker family
- Lack of physical activity and fitness
- Search for more convenient lifestyle



[#] Mozaffarian, et al NEJM: 6-23-2011 from Nurses and Health Professionals studies: largest factors in 4 year period – total weight change of 3.35 pounds: potato chips +1.69, potatoes +1.28, sugar sweetened drinks +1.00, meat +0.94; alcohol +0.41; new smokers +5.17, former smokers 0.14, sleep +0.31, TV watching +0.31 vegetables -0.22, fruits -0.49, yogurt -0.82; physical activity -1.76

Mortality

How bad is it and a paradox



Obesity at risk conditions

- Type 2 diabetes
- Cardiovascular diseases (but overall mortality rates from this cause gradually improving)
- Cardiovascular risk factors
- Cancer (World Cancer Research Fund report indicates between $\frac{1}{4}$ and $\frac{1}{3}$ of cancers are preventable)
- Kidney and liver
- Psychological
- Other, including quality of life



Challenges

- Long lag period between obesity and death
 - Results in need for long-term follow-up period for proper study, as it is the cumulative effect of adiposity exposure that adversely affects mortality
 - Importance of mitigating and accompanying factors
 - For example, changes in body composition over time and medical treatments, e.g., blood pressure, cholesterol
- Difficult to separate effects of
 - Weight, food intake, physical activity, fitness
 - Ultimately it is their combination that counts
- Forgotten in obesity discussions is the significant risk of being underweight



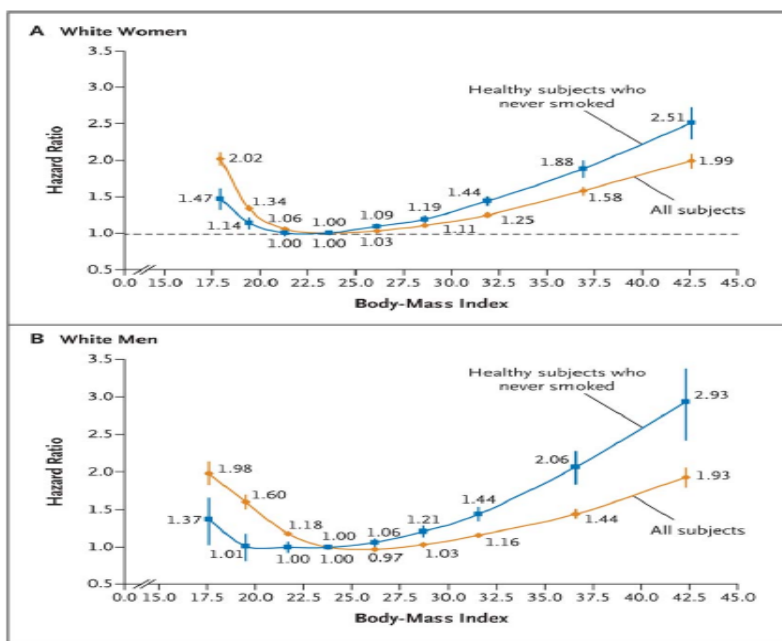
Analysis

- Significant differences exist between population segments, examples:
 - Asians, especially Southeast Asians, have less mortality tolerance for weight
 - Some developing countries may have different susceptibilities
 - Such as poor Mexicans with terrible nutritional habits, resulting in significant increase in diabetes
- By age, reflecting changes in body composition



Pattern from certain mortality studies

Figure 13
Estimated Hazard Ratios for Death from Any Cause According to Body-Mass Index for (A) All Study Participants and (2) Healthy Subjects Who Never Smoked



Source: Berrington de Gonzalez (2010)

J-curve relationship with BMI, from a recent pooled study of 19 large studies



Canadian studies

Authors	Katzmarzyk et al (2001)	Jain et al (2005)	Orpana et al (2008)	Katzmarzyk et al (2012)
Study	Canada Fitness Survey	Canada National Breast Screening Study	National Population Health Survey	Canada Heart Health Surveys
Participants	10,725	49,165	11,326	10,522
Initiation and follow-up	1981 for 13 years	1980-85 for 16.5 years	1994/5 for 12 years	1986/95 for 13.9 years
Ages at initial study	20-69	women 40-59	>25	18-74
BMI < 18.5	1.63	1.12	1.73	1.25 (1.30CVD; 1.02C)
18.5 - 24.9	1.00	1.00 (18.5-21.9) 1.15 (22.0-24.9)	1.00	1.00 (1.00CVD; 1.00C)
25.0 - 29.9	1.16	1.28 (25.0-27.9) 1.34 (28.0-29.9)	0.83	1.06 (1.57CVD; 1.14C)
30.0 - 34.9	1.25	1.30	0.95	1.27 (1.72CVD; 1.34C)
35.0+	2.96	1.40	1.36	1.65 (2.09CVD; 1.82C)



Obesity mortality paradox

- The paradox
 - Seemingly illogical results (those at a higher BMI have lower mortality)
- Initially seen in those treated for cardiovascular conditions, either because
 - Adiposity provides some protection or
 - Those obese of better than average health are tested and treated more rigorously
- Several recent studies have shown lower mortality for overweight and even those of moderate obesity



Obesity mortality paradox

- Contributing factors to this observed paradox include
 - Fat/adiposity location or body fat can be more important than weight
 - Body composition changes over time
- Indicates that mortality of those overweight is better than that of normal BMI category, and even that of class 1 obese experience is not adverse
- BMI is not an ideal metric, but is practical
 - It is only a surrogate for adiposity
 - Fat location is important
- Fitness can be more important than total weight
- May in some cases be due to inadequate follow-up study period
- Flegal (early 2013) paper prime recent example using BMI



Comparison of recent pooled data

BMI Range	Flegal (2013)	Berrington de Gonzalez (2010)	
		Females	Males
< 18.5	excluded	1.47	1.37
18.5 – 19.9	1.00	1.14	1.01
20.0 – 24.9	1.00	1.00	1.00
25.0 – 29.9	0.94	1.13	1.13
30.0 – 34.9	0.95*	1.44	1.44
35.0 – 39.9	1.29*	1.88	2.06
40.0 – 44.9		2.51	2.93
>= 45.0	excluded		



* Obesity classes 1-3: 1.18

Paradox issues

1. BMI not a good measure of obesity
 - Location of adiposity tissues and fatness may be more important than overall weight
 - Waist circumference or waist-to-hip ratio may be better
2. The “normal” BMI benchmark may no longer be best for mortality analysis
 - Effect of higher mortality of underweight and those with BMI <22.5
 - Some believe especially applicable for older ages
3. Reverse causation
 - Especially due to the effect of smoking and co-morbidities



Paradox issues

4. Weight change
 - Not only current weight, but weight history is important
5. Normal BMI category is quite diverse
 - May include a higher mix of unhealthy lives
6. Each BMI category consists of heterogeneous group of individuals
 - Distribution of other factors may affect comparisons
7. Physical activity and fitness
 - Some studies have indicated fitness is quite important
8. Treatment



▪ The obese may visit physicians more often and treated more aggressively

Paradox issues

9. Age, especially those at older ages

- Body structure changes
- Usually less follow-up

10. Protective value

- Additional fat stores may be valuable regarding mortality in some cases

11. Representativeness

- Surveys may be biased
 - For example, those institutionalized
- More recent observations have shown the differential effect of obesity on mortality may be reduced



Paradox issues

12. Study period

- Currently shorter time with obesity due to recent epidemic
- Time between measurement and outcome may be too short in some cases

13. Self-reporting bias

- Has different results than professionally measured

14. Inappropriate sample of studies

- In a mega-study, care needed to include all representative studies

15. Prevalence of more extreme obesity

- Current distribution of obesity has changed



Projections

- Simple extrapolations may be biased (just as current effect of recent decreases in smoking will not continue)
 - What will be the long-term effects of carrying extra weight over the long-term, for example from childhood onward?
- Early indication that those currently at younger ages in developed countries may not see the same level of mortality improvement as earlier
 - Reither, Olshansky et al (*Health Affairs*, August 2011), “New Forecasting Methodology Indicates more Diseases and Earlier Mortality Ahead for Today’s Younger Americans” suggests use of projection cohorts
 - Mehta and Chang (2011) point out that adverse obesity trends may not prove as mortality-adverse as in earlier mortality studies, in part due to significant decreases in cardiovascular diseases



Summary

- The morbidly obese (class 2+, BMI ≥ 35) are clearly at mortality risk
 - The fastest growing population weight segment
- Class I obese (BMI between 30 and 34.9), although certainly a morbidity risk, may not be a significant mortality risk
- The relative mortality risk of those overweight ($25 < \text{BMI} < 30$) is still in question, with inconsistent results from different studies



Health It can get worse



Health costs

- Overweight and obese generally perceived to bear additional costs
 - Both direct (medical costs) and indirect (loss of wages, productivity, life quality)
 - Particularly associated with the morbidly obese, higher prescription drug costs and more hospital admittances
 - Disability, loss of productivity and wages
 - No morbidity paradox observed



Health costs

- Excess cost of obesity
 - Effect of better mortality of overweight and obese will have adverse effects on future morbidity
 - Earlier studies indicated between 5-7% of total U.S. health care cost
 - Certain recent studies suggest between 9-16% (Finkelstein, et.al.; Cawley & Mayerhoefer), with focus on effect of the growing number of class 2+ obese



What can be done It won't be easy



Prevention/Management

- Diet
 - But few diets work – especially challenging since eating is necessary and human behavior makes eating to excess difficult to stop
- Food, beverage and eating out
- Physical activity / fitness
- Education / labeling (though many ignore)
- Bariatric surgery (recent studies are positive)
- Pharmacotherapy
- Schools, workplace and community
- Behavior therapy
- Government, including taxation



