

# Burden of Preventable Disease in North Carolina

Mark Holmes, PhD  
Vice President, NC IOM  
Task Force on Prevention  
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Excellent research assistance provided by Christine Nielsen.

# Overview

- Definitions and nomenclature
- North Carolina data on leading causes of death and disability
- Actual causes of death and disability (“risk factors”)

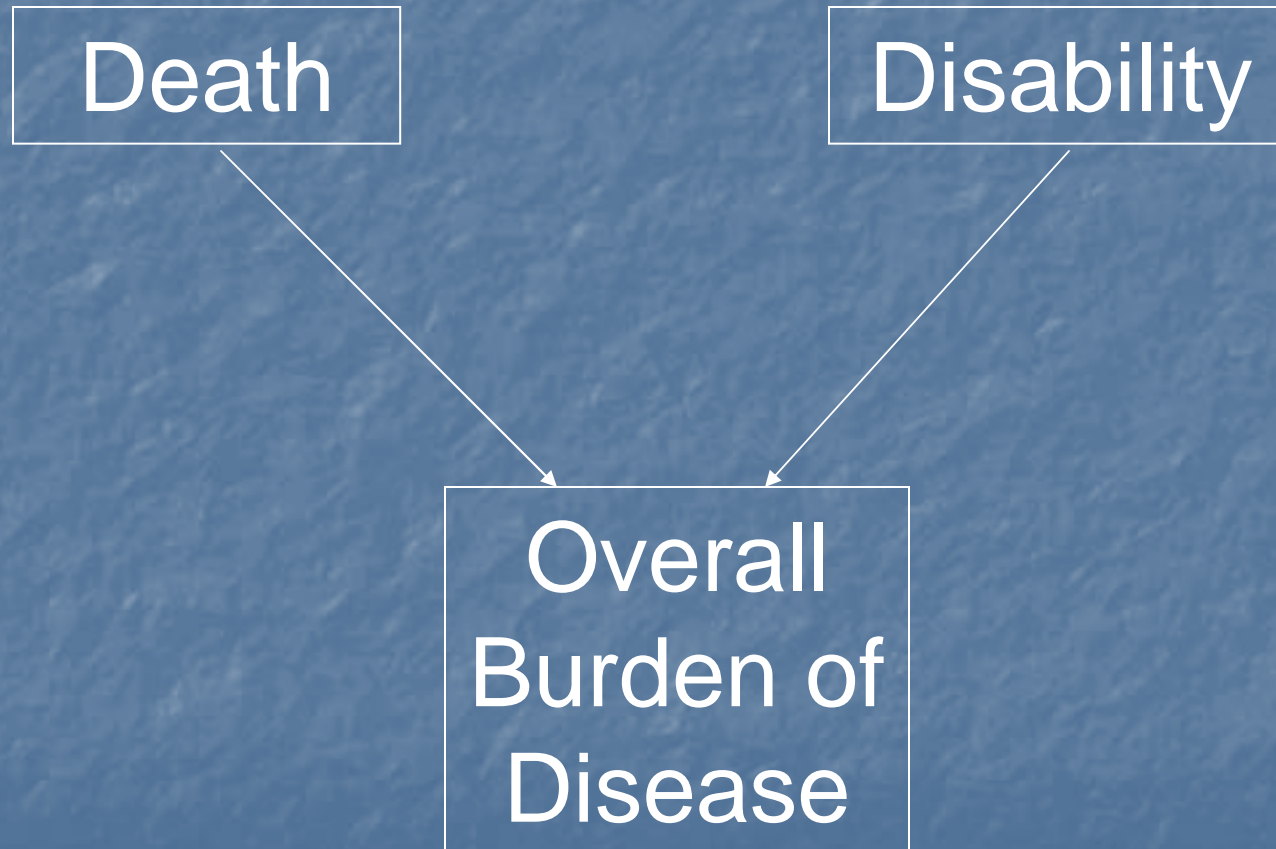
# Definitions

- Preventable disease can affect health in many ways
  - Mortality – death from the disease
  - Morbidity – disability from the disease
- Research has tended to focus on the former – it's easier to measure

# Specific Measures

- Lots of measures for these different concepts
  - Death rate
  - QALY
  - DALY
  - YLL
  - YLD
  - YPLL
  - Oh my!

# Measuring Disease Burden



Death

Disability

Overall  
Burden of  
Disease

```
graph TD; A[Death] --> C[Overall Burden of Disease]; B[Disability] --> C;
```

The diagram consists of three rectangular boxes. The top-left box contains the word 'Death' in white text. The top-right box contains the word 'Disability' in dark blue text. The bottom-center box contains the text 'Overall Burden of Disease' in dark blue text, arranged in three lines. Two arrows originate from the bottom-right corner of the 'Death' box and the bottom-left corner of the 'Disability' box, both pointing towards the top-left corner of the 'Overall Burden of Disease' box.

# Years of Life Lost (YLL)

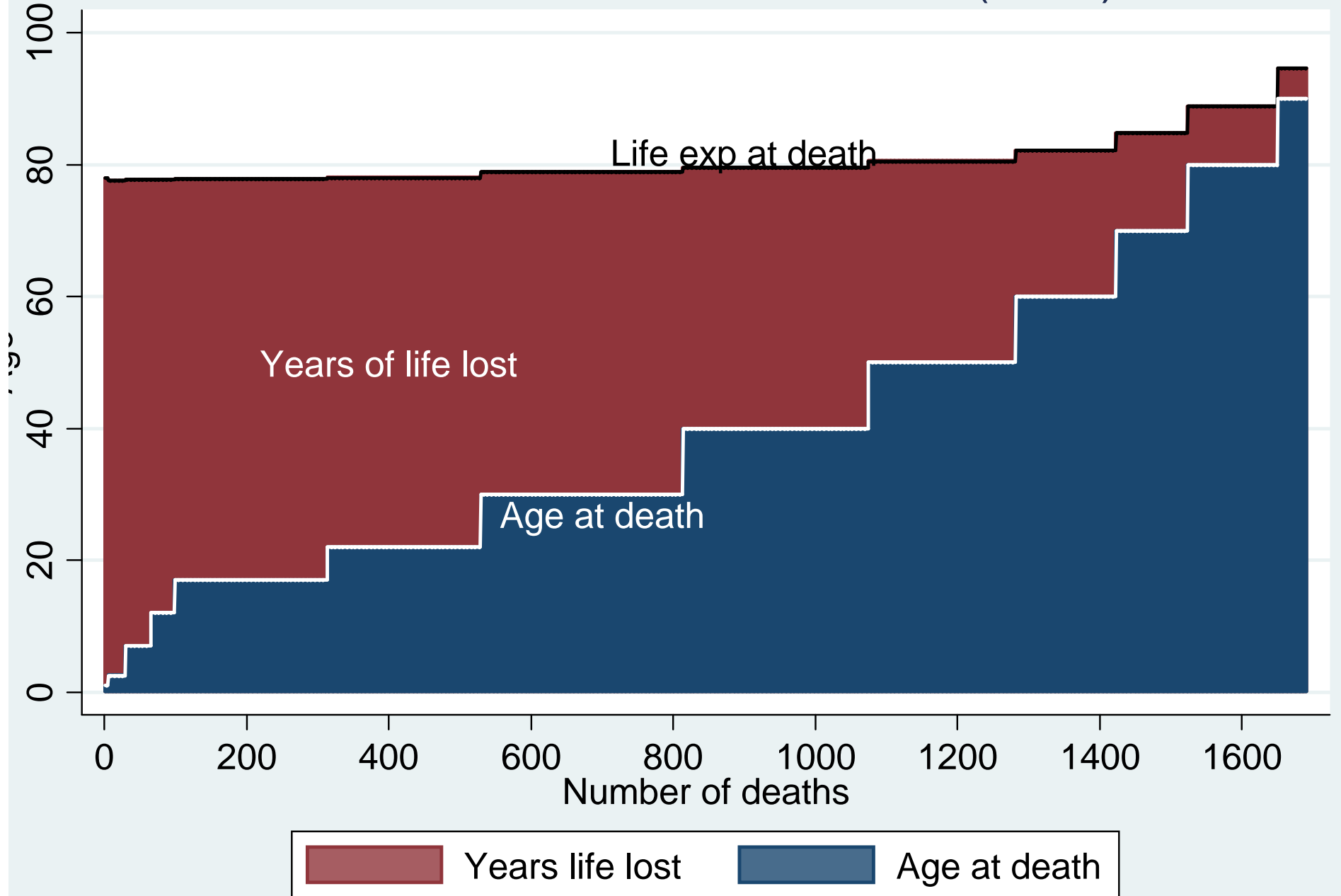
- Measure of mortality
- Calculate the lost years of life due to the death
- Lost years of life = life expectancy *at age of death* – current age
- Places more weight on death at earlier age

# Examples

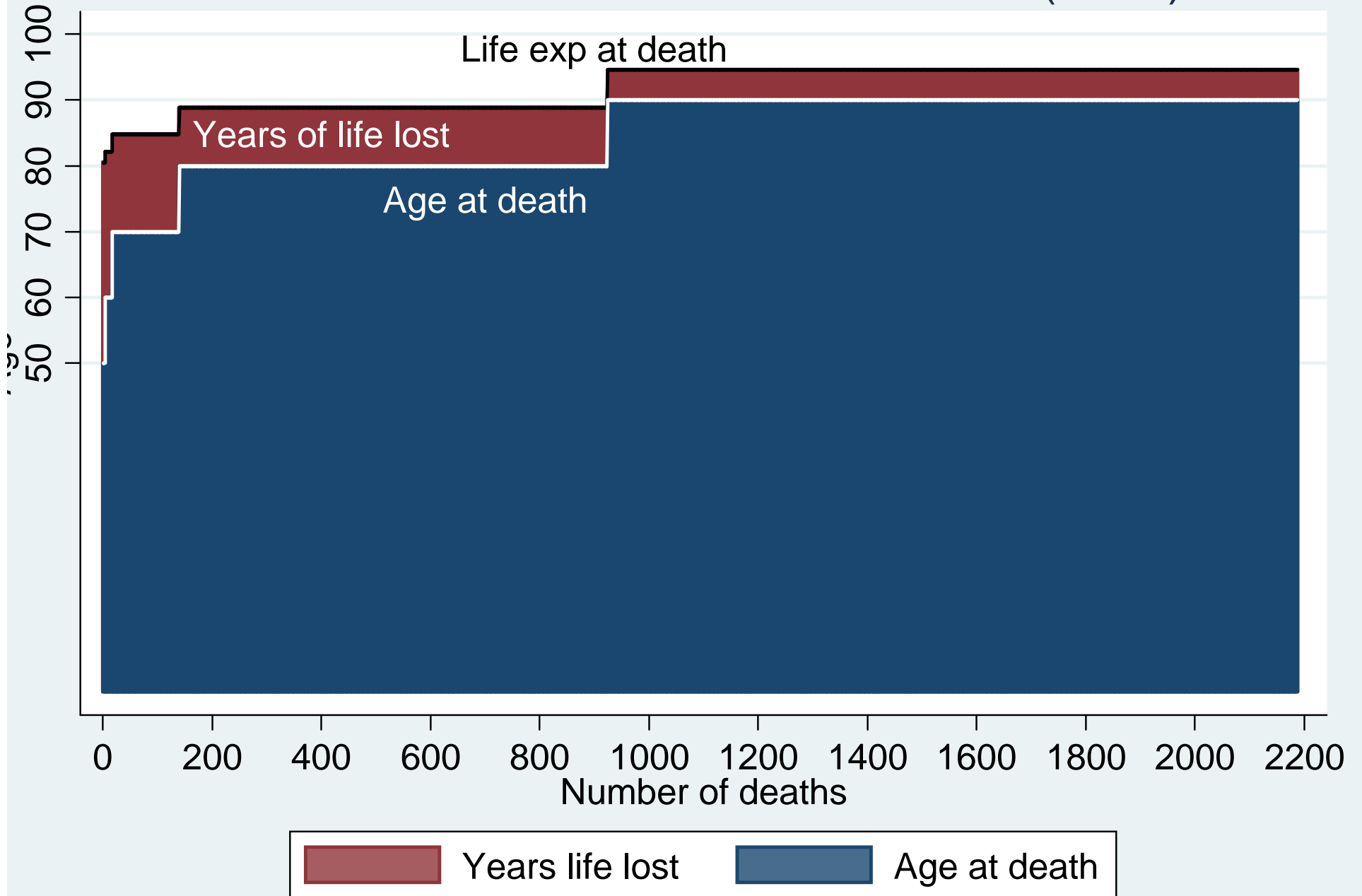
- At Age 0: Life expectancy = 76 years
  - $YLL = 76 - 0 = 76$
- At Age 50: Life expectancy = 80 years
  - $YLL = 80 - 50 = 30$
- At Age 75: Life expectancy = 86 years
  - $YLL = 86 - 75 = 11$

Deaths at earlier ages are weighted more.

# Years of Life Lost due to MVA (2005)



# Years of Life Lost due to Alzheimers (2005)



# Sample (NC)

**Table 1: 2005 NC Ten Leading Causes of Death: Total Deaths and Years of Life Lost**

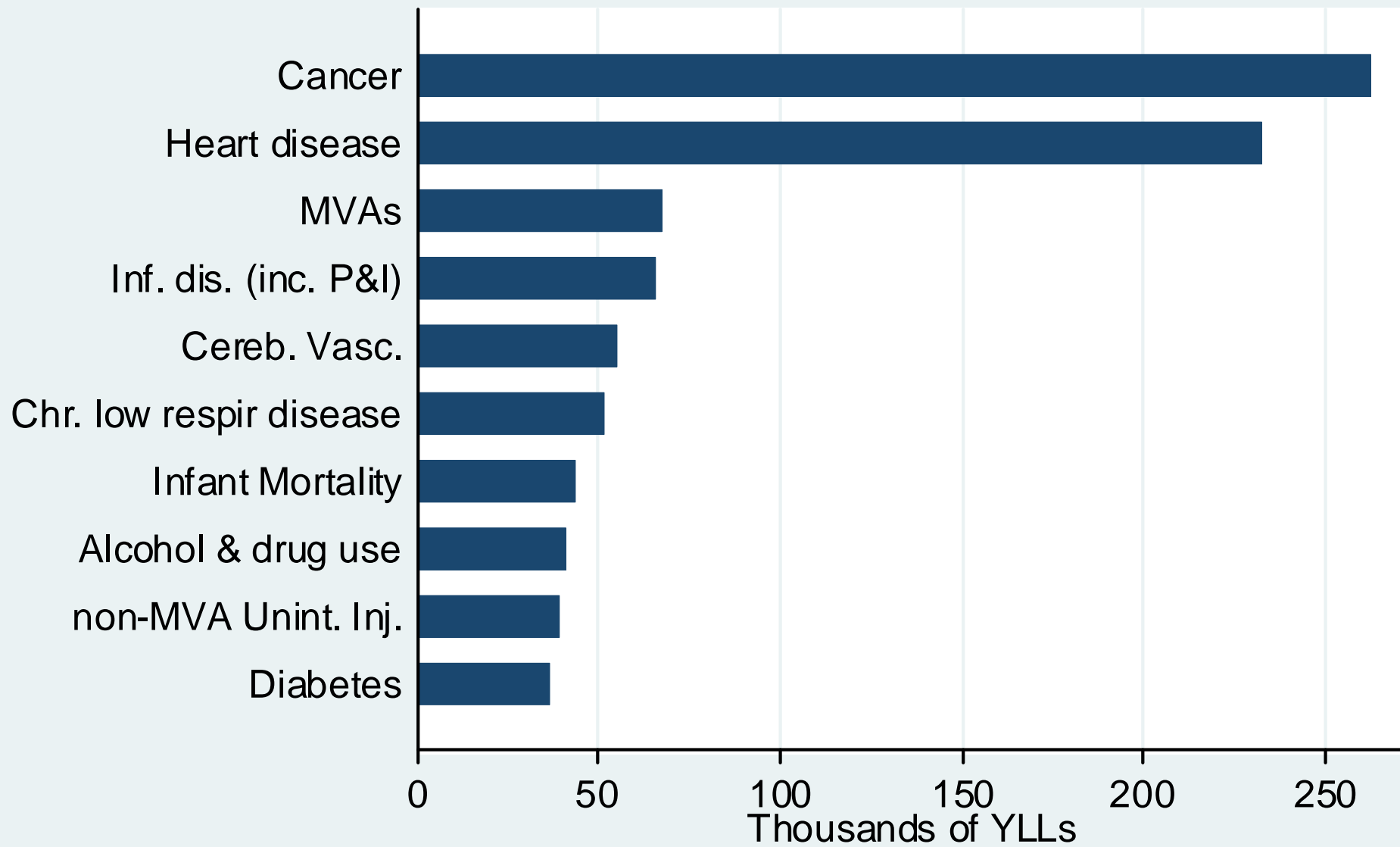
<b>Rank Cause</b>	<b>Total Deaths</b>	<b>Average Years of Life Lost</b>	<b>Total Years of Life Lost</b>
1 Heart disease .....	17,681	6.0	105,982
2 Cancer .....	16,675	8.7	145,219
3 Stroke .....	4,846	4.6	22,335
4 Chronic lower respiratory diseases .....	4,145	4.6	19,095
5 Other unintentional injuries .....	2,448	22.2	54,414
6 Alzheimer's disease .....	2,414	0.5	1,275
7 Diabetes .....	2,255	7.7	17,350
8 Pneumonia and influenza .....	1,820	4.0	7,359
9 Motor vehicle injuries .....	1,636	35.7	58,439
10 Nephritis, nephrotic syndrome, nephrosis ...	1,549	5.5	8,523
<b>Total Deaths – All Causes .....</b>	<b>74,376</b>	<b>9.5</b>	<b>703,302</b>

# Available Data

- YLL: pretty good NC data
  - NC State Center for Health Statistics
    - Vital statistics
    - Life expectancy
  - Group similar conditions (e.g. heart disease, cancers)
    - Work off 113 causes of death using ICD-10 codes

# Years of Life Lost

In Thousands of YLLs, 2006



Death

Disability

Overall  
Burden of  
Disease

```
graph TD; A[Death] --> C[Overall Burden of Disease]; B[Disability] --> C;
```

The diagram illustrates the components of the overall burden of disease. It features three rectangular boxes. At the top left, a box contains the word 'Death'. At the top right, a box contains the word 'Disability'. At the bottom center, a larger box contains the text 'Overall Burden of Disease'. Two arrows originate from the bottom of the 'Death' and 'Disability' boxes and point towards the top of the 'Overall Burden of Disease' box, indicating that both death and disability contribute to the overall burden.

# Years Life Lost to Disability (YLD)

- (A misleading definition – think “years lost to disability”)
- Morbidity-only measure
- $YLD = \text{condition-specific weight} * \text{years with condition}$
- Weight ranges from 0 (perfect health) to 1 (death)
  - The weights are the “transmission” – research-based

# Example weights

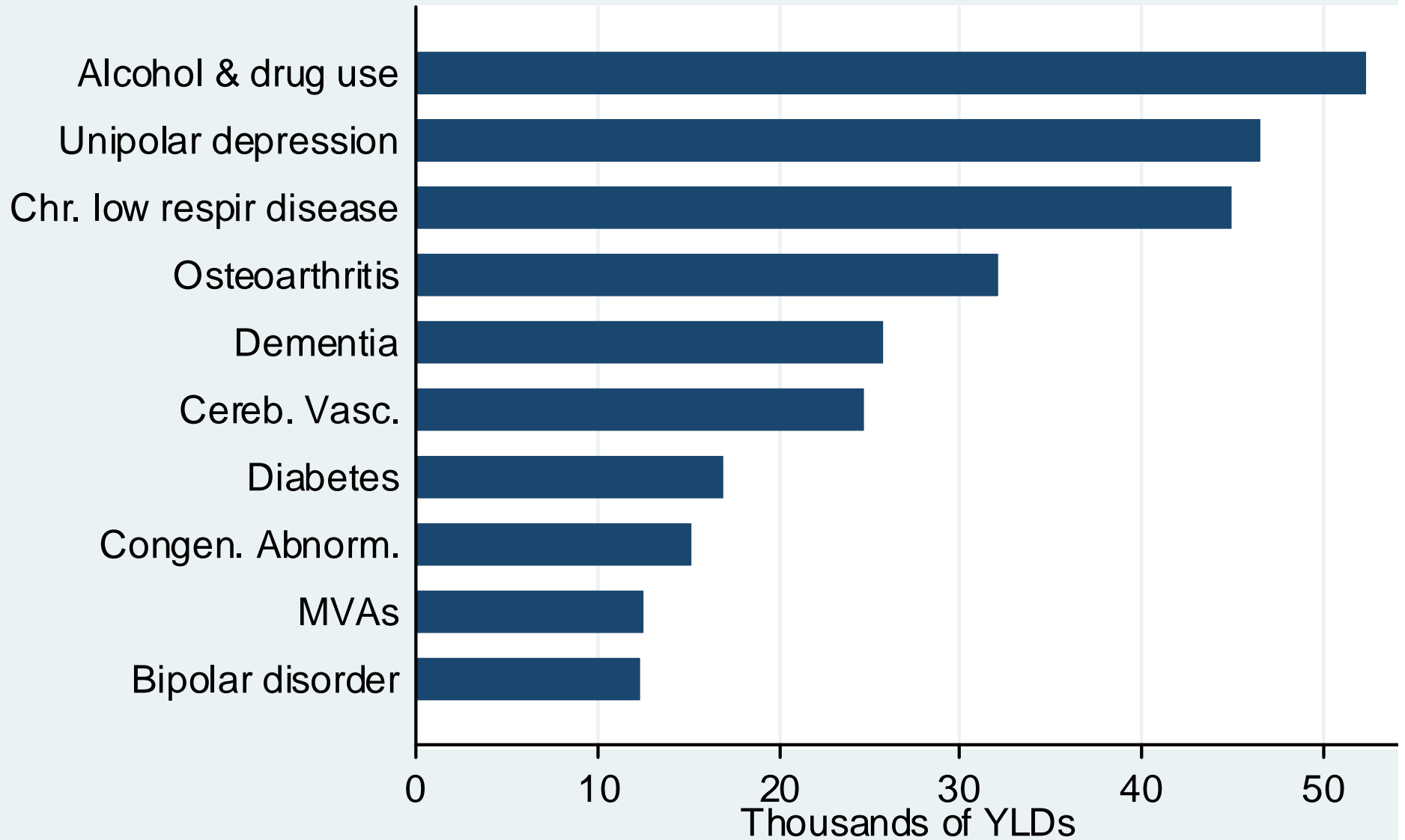
Condition	Disability Weight
Otitis media	.023
Bipolar affective disorder	.367
Alzheimer's	.666
Acute myocardial infarction	.437
Episode of limiting low back pain	.061
Breast cancer	.09
Amputated arm	.257

# Available Data

- YLD: great data do not exist
  - Michaud et al. use 1996 US data
  - We adjust for population differences between US and NC, 1996 and 2005
- Data omit some diseases we know have morbidity burden
  - Back pain:  $10\% * .061 * 6.5 \text{ million} = 39,650 \text{ YLD}$
  - Cancer
  - No attempt to “improve” upon Michaud estimates

# Morbidity Burden

In Thousands of YLDs, 2005



Death

Disability

Overall  
Burden of  
Disease

```
graph TD; A[Death] --> C[Overall Burden of Disease]; B[Disability] --> C;
```

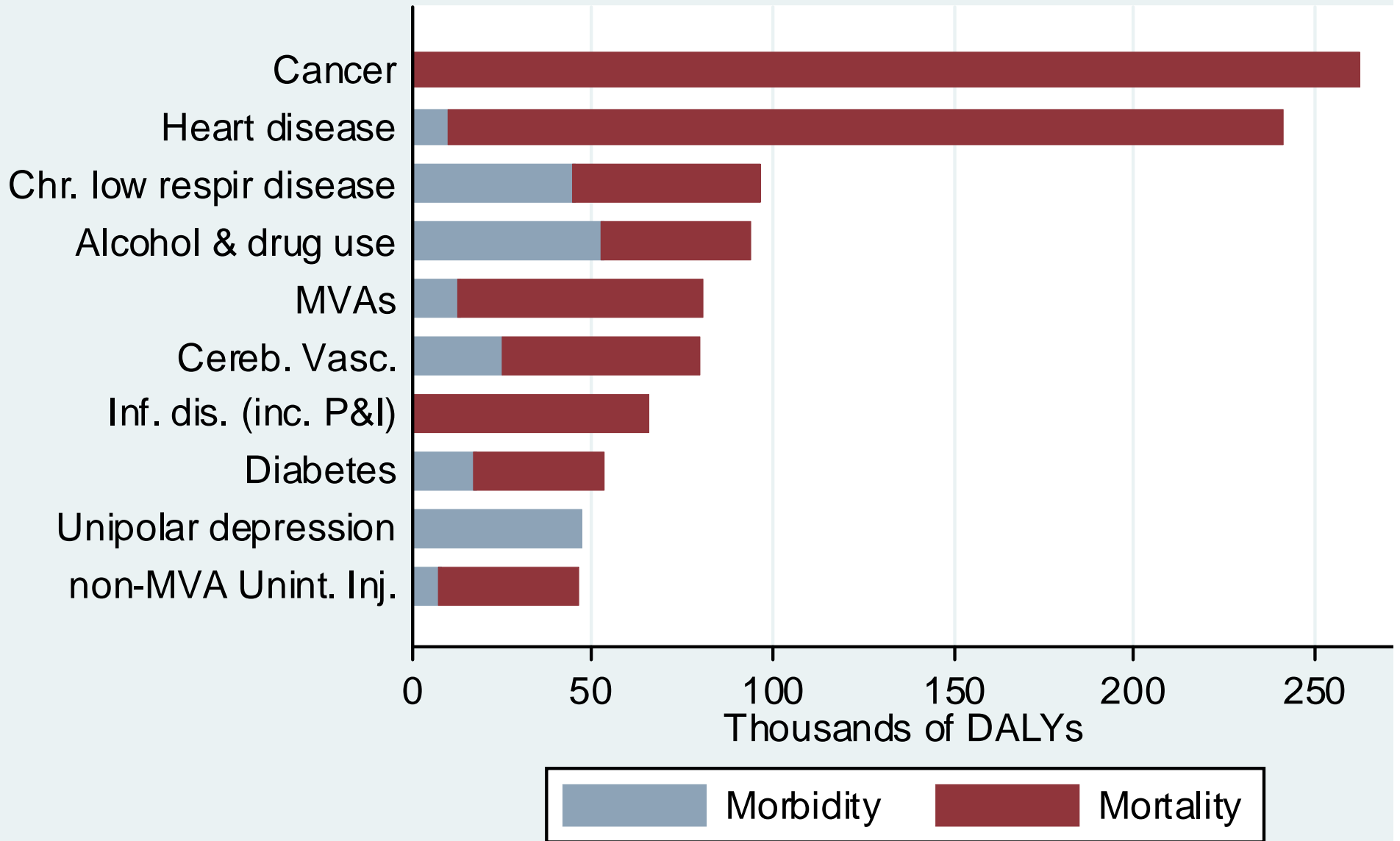
The diagram illustrates the components of the overall burden of disease. It features a dark blue background with three rectangular boxes. At the top left, a box contains the word 'Death'. At the top right, a box contains the word 'Disability'. Both boxes have dark blue text and a dark blue border. Two arrows originate from the bottom center of each of these top boxes and point towards a central box at the bottom. This central box contains the text 'Overall Burden of Disease' in white, with each word on a new line. The central box has a white border.

# Disability-Adjusted Life Year (DALY)

- $DALY = YLL + YLD$ 
  - Mortality burden plus morbidity burden
- Implicitly assumes tradeoff:
  - Living 1 year of perfect health [ $1 * (1 - 0) = 1$  healthy year]
  - Living 2 years at .5 disability [ $2 * (1-.5) = 1$  healthy year]
  - Living 3 years at .666 disability [ $3 * (1-.666) = 1$  healthy year]
- In other words, one year at perfect health “equals” three years with Alzheimer’s

# NC Disease Burden

In Thousands of DALYs, 2005



# *Leading vs. Actual*

- *Leading* causes of death and disability differ from the *actual* causes
- What is the underlying root cause of the disease?
  - Mokdad et al, JAMA (2004) calculate the years of life lost (n.b. – no disability) for top ten causes

# *Leading Causes of Death*

**Table 1.** Leading Causes of Death in the United States in 2000\*

Cause of Death	No. of Deaths	Death Rate per 100 000 Population
Heart disease	710 760	258.2
Malignant neoplasm	553 091	200.9
Cerebrovascular disease	167 661	60.9
Chronic lower respiratory tract disease	122 009	44.3
Unintentional injuries	97 900	35.6
Diabetes mellitus	69 301	25.2
Influenza and pneumonia	65 313	23.7
Alzheimer disease	49 558	18
Nephritis, nephrotic syndrome, and nephrosis	37 251	13.5
Septicemia	31 224	11.3
Other	499 283	181.4
<b>Total</b>	<b>2 403 351</b>	<b>873.1</b>

# Determining *Actual* Causes of Death

- What we would *like* is the relative risk of death and/or disability for each risk factor
  - For example, smoking increases your risk of death by heart disease by 68%, quadruples risk of death by lung cancer, etc.
- Comprehensive data on this front do not exist
  - Mokdad et al. collected risks of (non-specific cause) death due to each risk factor
- Best we can do: compile risk factors for each disease, unable to quantify

# *Actual* Causes of Death

**Table 2.** Actual Causes of Death in the United States in 1990 and 2000

Actual Cause	No. (%) in 1990*	No. (%) in 2000
Tobacco	400 000 (19)	435 000 (18.1)
Poor diet and physical inactivity	300 000 (14)	400 000 (16.6)
Alcohol consumption	100 000 (5)	85 000 (3.5)
Microbial agents	90 000 (4)	75 000 (3.1)
Toxic agents	60 000 (3)	55 000 (2.3)
Motor vehicle	25 000 (1)	43 000 (1.8)
Firearms	35 000 (2)	29 000 (1.2)
Sexual behavior	30 000 (1)	20 000 (0.8)
Illicit drug use	20 000 (<1)	17 000 (0.7)
<b>Total</b>	<b>1 060 000 (50)</b>	<b>1 159 000 (48.2)</b>

# Actual Causes Considered

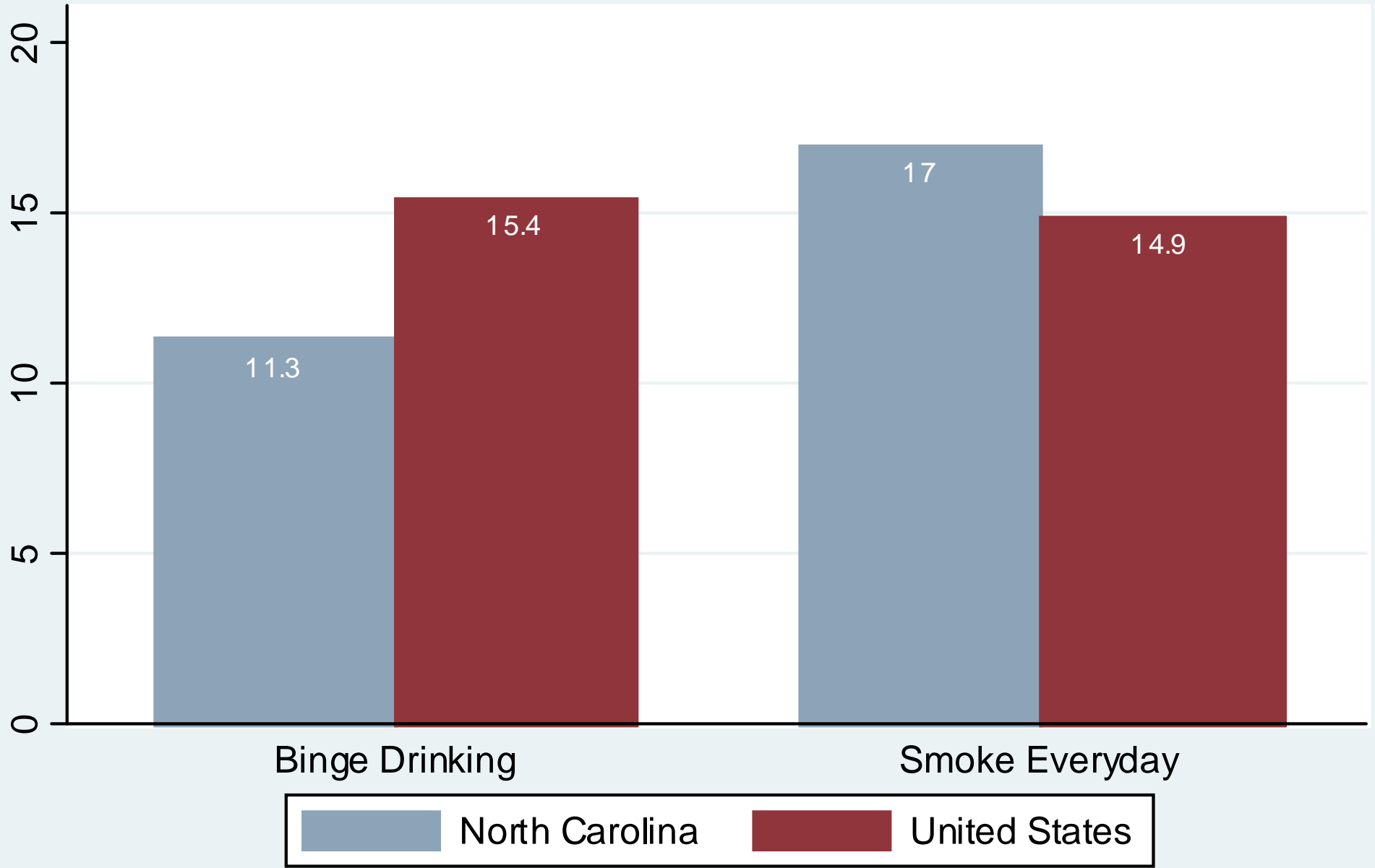
- Alcohol and drug use
- Bacteria and infectious agents
- Diet, physical inactivity, overweight, obesity
- Emotional and psychological factors
- Exposure to chemicals and environmental pollutants
- Tobacco
- Risky sexual behavior

# Risk Factors for Leading Causes

Leading causes of morbidity and mortality	Underlying Causes							
	Alcohol and drug use	Bacteria and infectious agents	Diet, physical inactivity, overweight, obesity	Emotional and psychological factors	Exposure to chemicals and environmental pollutants	Tobacco	Risky sexual behavior	
	Cancer	✓		✓		✓	✓	
	Heart disease	✓		✓	✓		✓	
	Motor vehicle injuries and accidents	✓						
	Other unintentional injuries	✓		✓			✓	
	Chronic lower respiratory diseases			✓		✓	✓	
	Cerebrovascular disease	✓		✓			✓	
	Alcohol and drug use	✓			✓			
	Unipolar major depression	✓			✓		✓	
Diabetes			✓					
Infectious diseases	✓	✓			✓		✓	

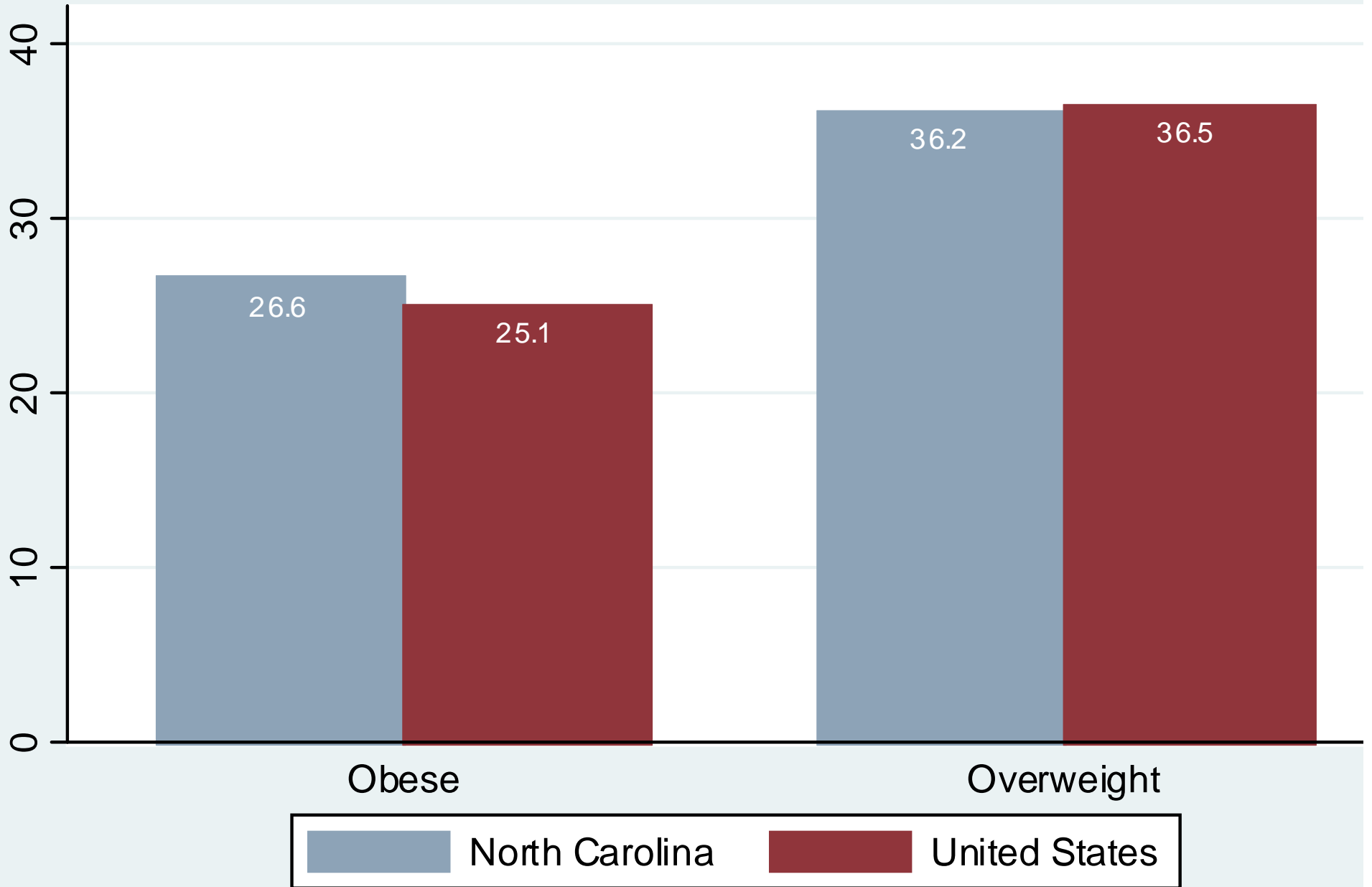
# Prevalence of Certain Risk Factors

## Prop. Ever Smoking and Binge Drinking



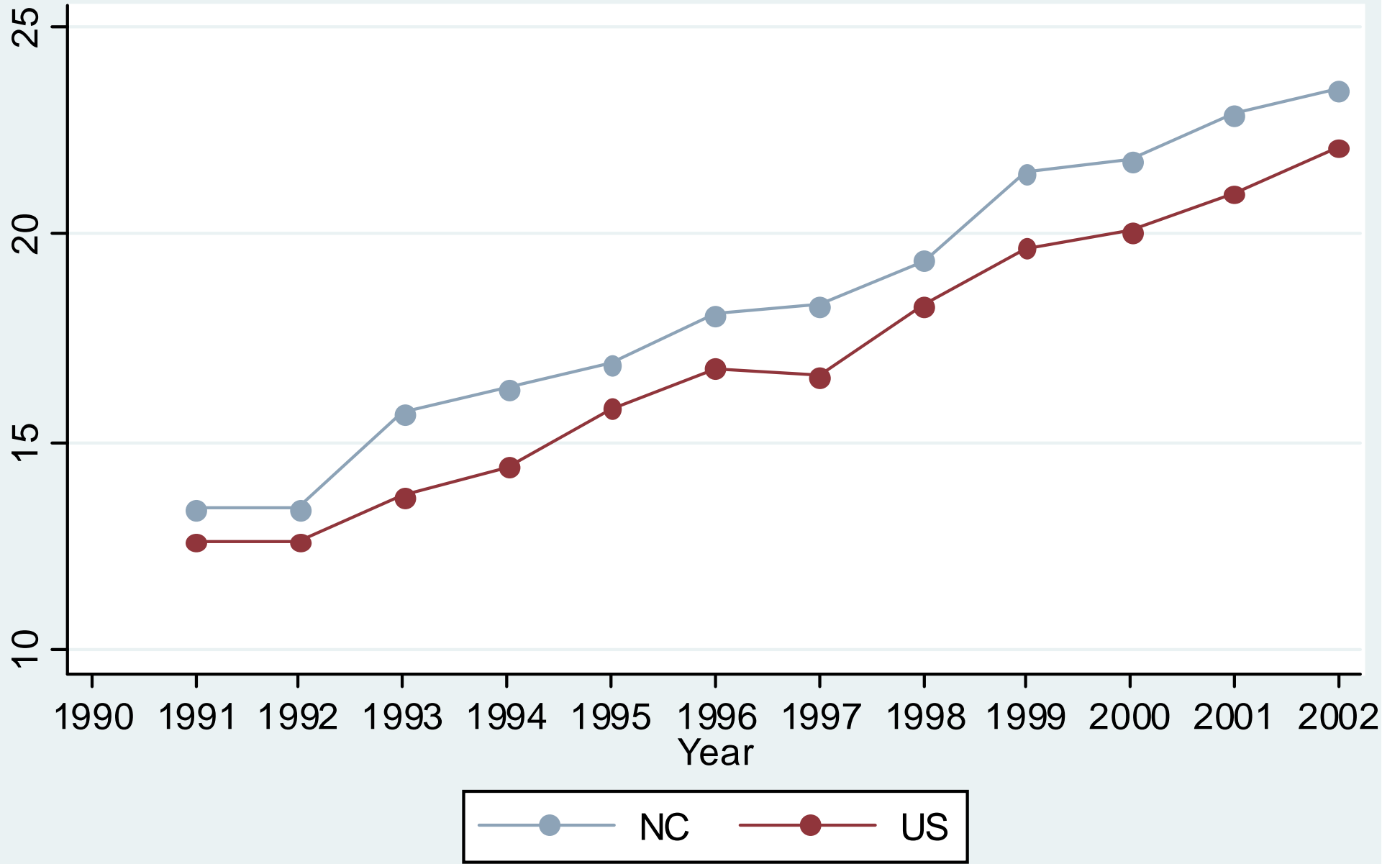
Source: Behavioral Risk Factor Surveillance System (2006)

# Prevalence of Overweight and Obesity



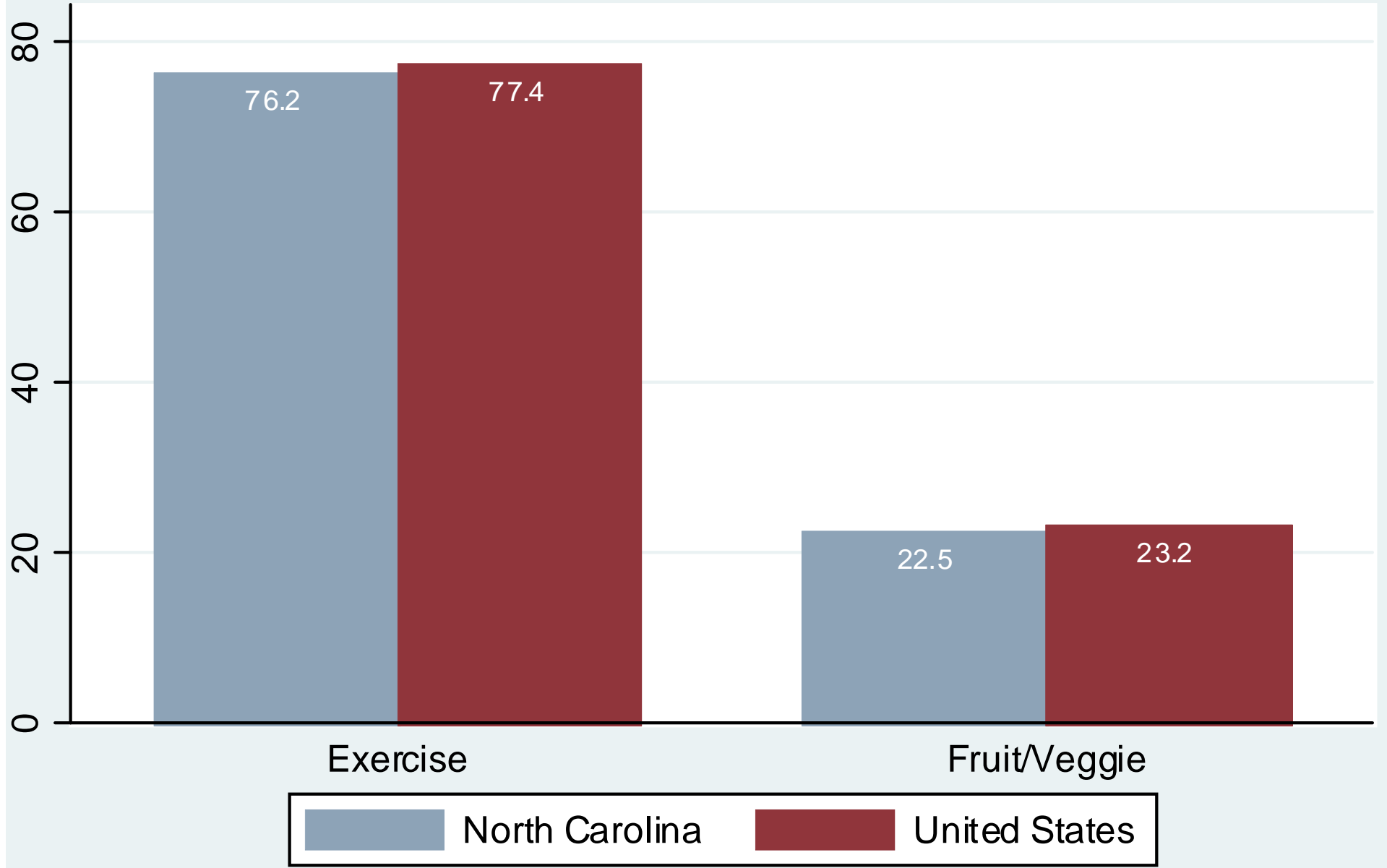
Source: Behavioral Risk Factor Surveillance System (2006)

# Percent of Adults Obese



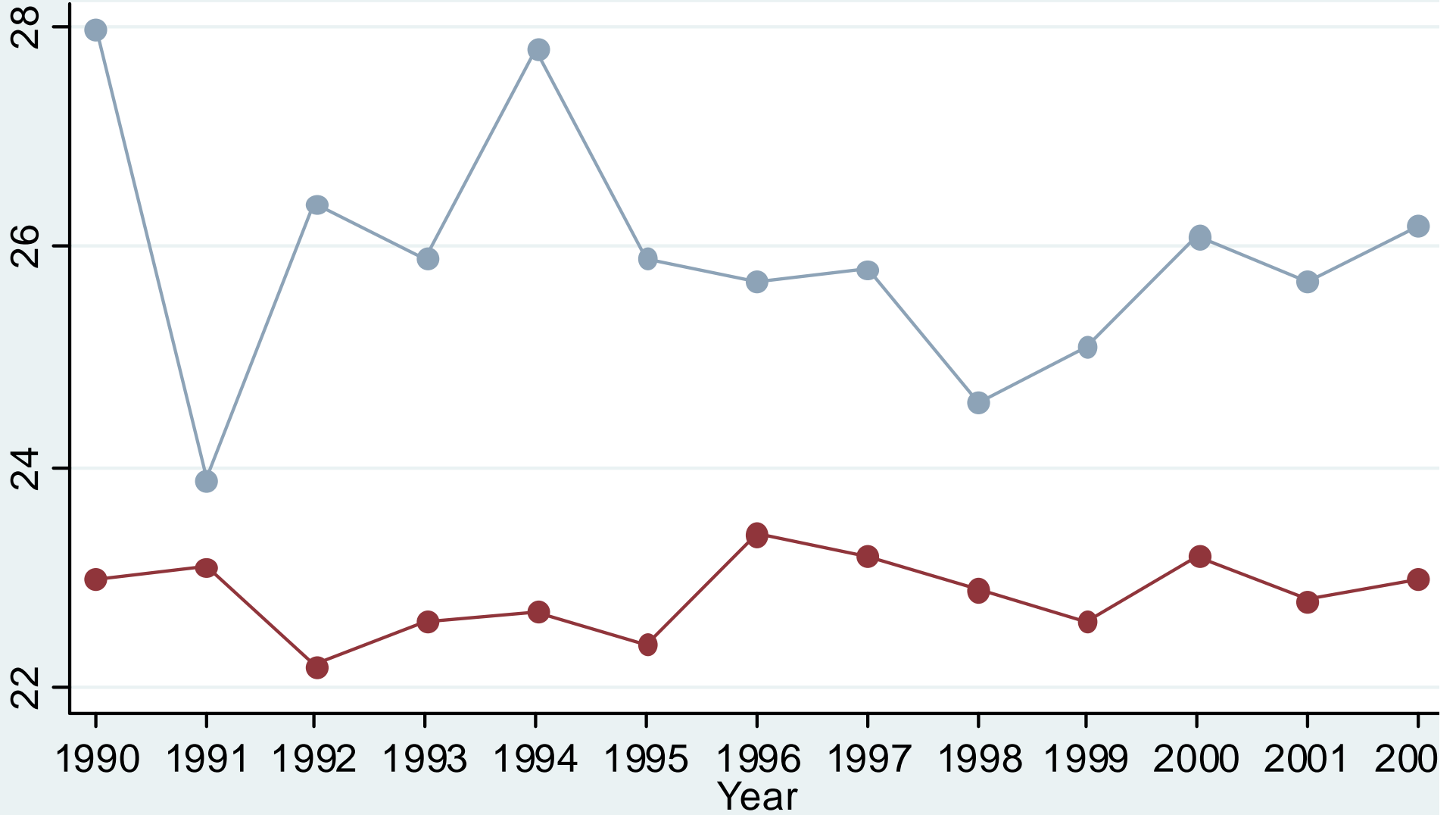
Source: Behavioral Risk Factor Surveillance System

# Prop. Eating 5 Fruits/Vegs per day and Exercise Past Month



Source: Behavioral Risk Factor Surveillance System (2006) [Fruits/Veggie 2005]

# Percent of Adults Currently Smoking



—●— North Carolina    —●— United States

Source: Behavioral Risk Factor Surveillance System

# Conclusion

- Disease burden should include mortality and morbidity to get proper assessment
- To better focus prevention efforts, should consider *actual* causes of disease rather than *leading* causes