Low Cardiovascular Risk and Ideal Cardiovascular Health:
Population-Based Primordial Prevention

Christina M. Shay, PhD, MA

Postdoctoral Fellow
Department of Preventive Medicine
Northwestern University
c-shay@northwestern.edu

NORTHWESTERN UNIVERSITY
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Presentation Overview

- "Low Cardiovascular Risk"

- Evidence for value of the Low Risk phenotype in reduction and prevention of CVD

- "Ideal CV Health": American Heart Association's Strategic Impact Goals

- Current state of ideal CV health in U.S. adults

- Association between CV behavioral and factors in U.S. adults

- Future Directions

Low Cardiovascular Risk

Jeremiah Stamler, MD

"Individuals with optimal levels of all major CVD risk factors"

- Serum total cholesterol <200 mg/dL
- SBP/DBP $\leq$ 120/80 mmHg
- Body Mass Index < 25 kg/m^2
- Not a current smoker
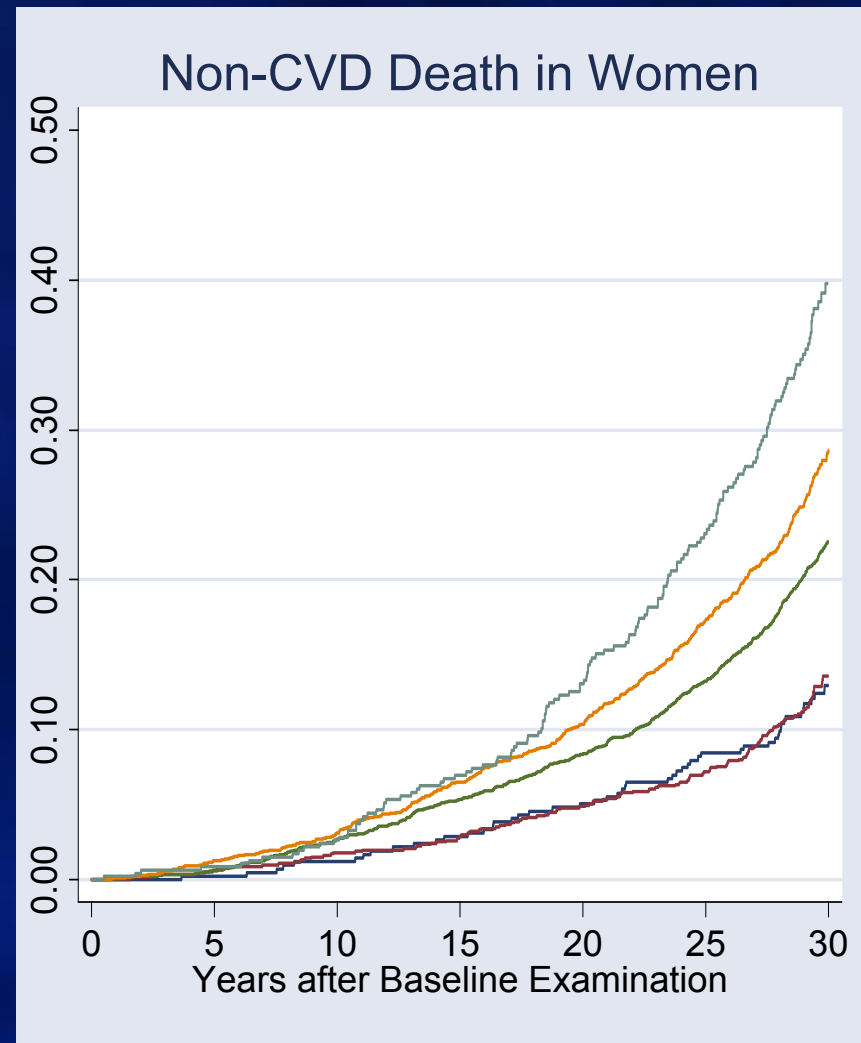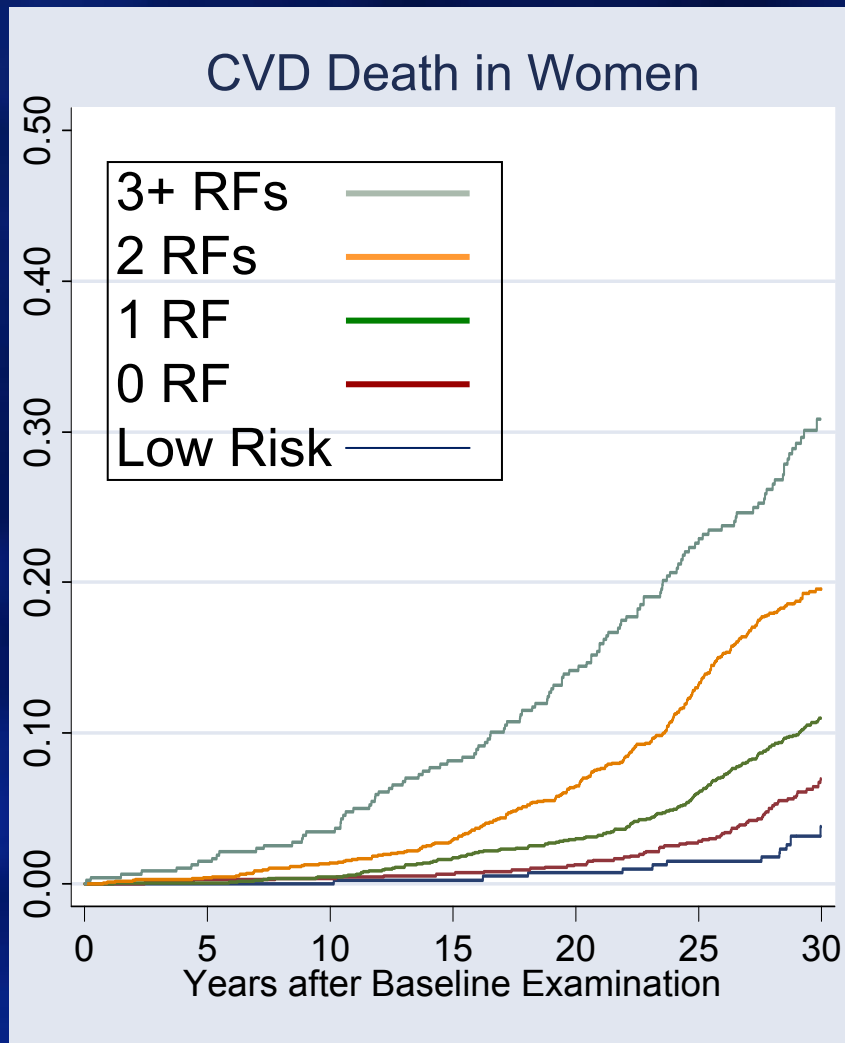- No history of diabetes
- No history of CVD

Stamler, JAMA 1999
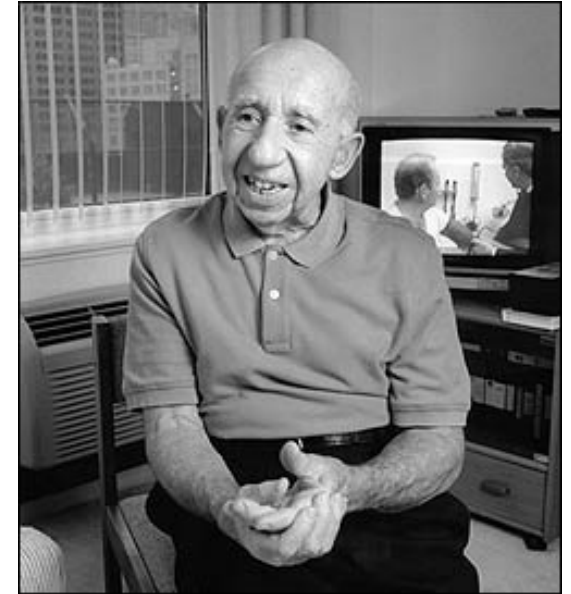
Risk Reduction and Life Years Gained from Low Risk Status

Multiple Risk Factor Intervention Trial (MRFIT)
Chicago Heart Association Detection Project in Industry (CHA)

	CVD Mortality	All-Cause Mortality	Greater Life Expectancy
MRFIT men (35-39)	- 85%	- 50%	+ 6.3 years
CHA men (18-39)	- 80%	- 57%	+9.5
MRFIT men (40-57)	- 76%	- 55%	+5.9
CHA men (40-59)	- 72%	- 58%	+6.0
CHA women (40-59)	- 73%	- 40%	+5.8

Stamler, JAMA 1999

Risk for CVD and Non-CVD Death by CVD Risk Factor Burden (CHA)

CVD Death in Women

Non-CVD Death in Women

3+ RFs
2 RFs
1 RF
0 RF
Low Risk

Years after Baseline Examination

Years after Baseline Examination

Lifetime Risks for All ASCVD
Cardiovascular Lifetime Risk Pooling Project

Men, Age 45

Berry, AHA 2007
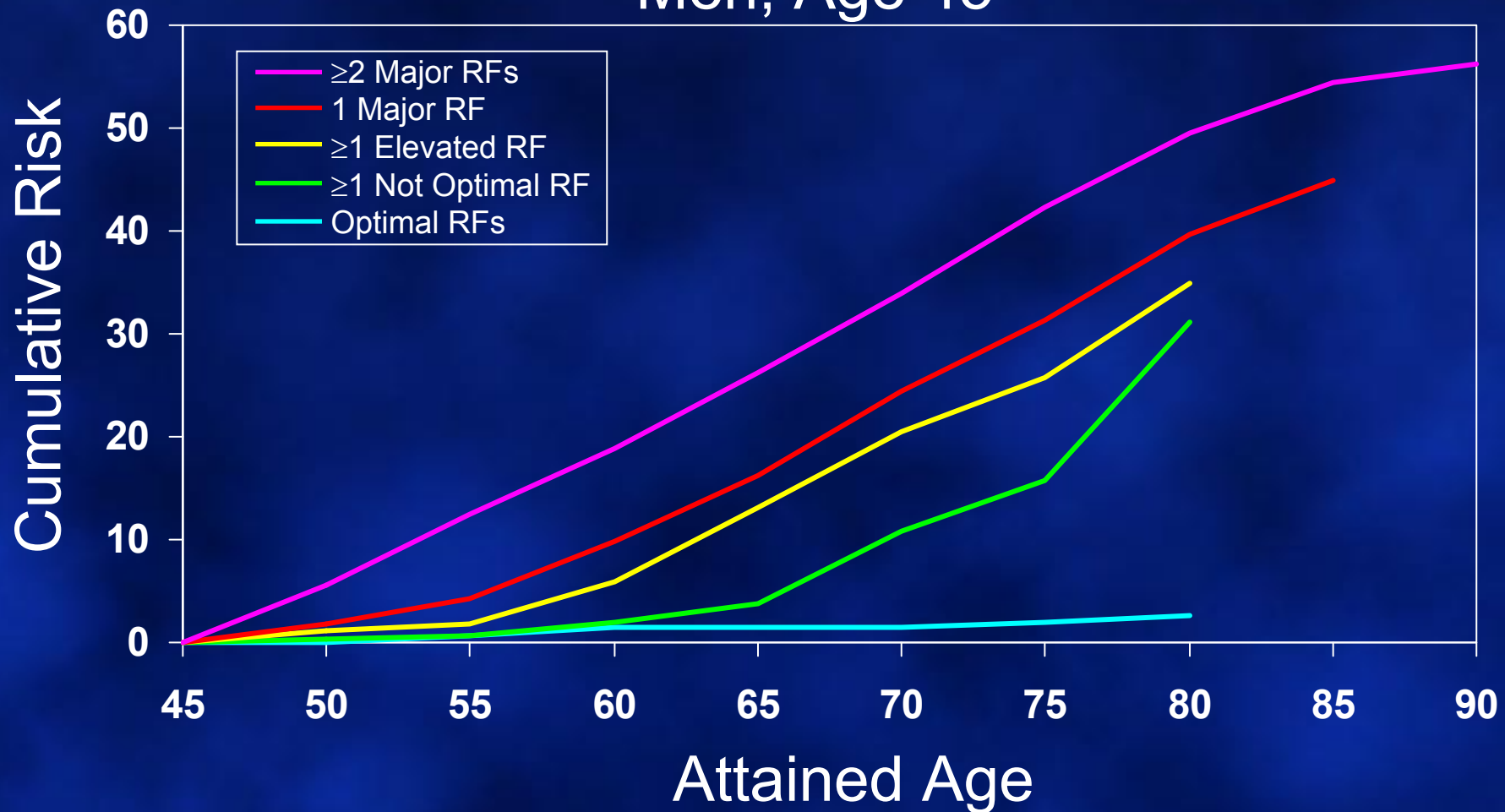
Median Survival by Risk Factor Strata
Age 50 – Framingham

RF Stratum	Men	Women
All Optimal RFs	>40 years	>40 years
≥1 Not Optimal RFs	36	39
≥1 Elevated RF	35	39
1 Major RF	30	35
≥2 Major RFs	28	31

Prevalence by Risk Factor Strata at Age 50 – Framingham

RF Stratum	Men (n=3564)	Women (n=4362)
All Optimal RFs	3.2%	4.5%
≥1 Not Optimal RFs	11.0%	13.8%
≥1 Elevated RF	23.2%	24.1%
1 Major RF	42.3%	40.5%
≥2 Major RFs	20.3%	17.1%

Lloyd-Jones, *Circulation* 2006.

RF Burden in Middle Age and QOL in Older Age
Prevalences of Favorable QOL Measures (CHA)
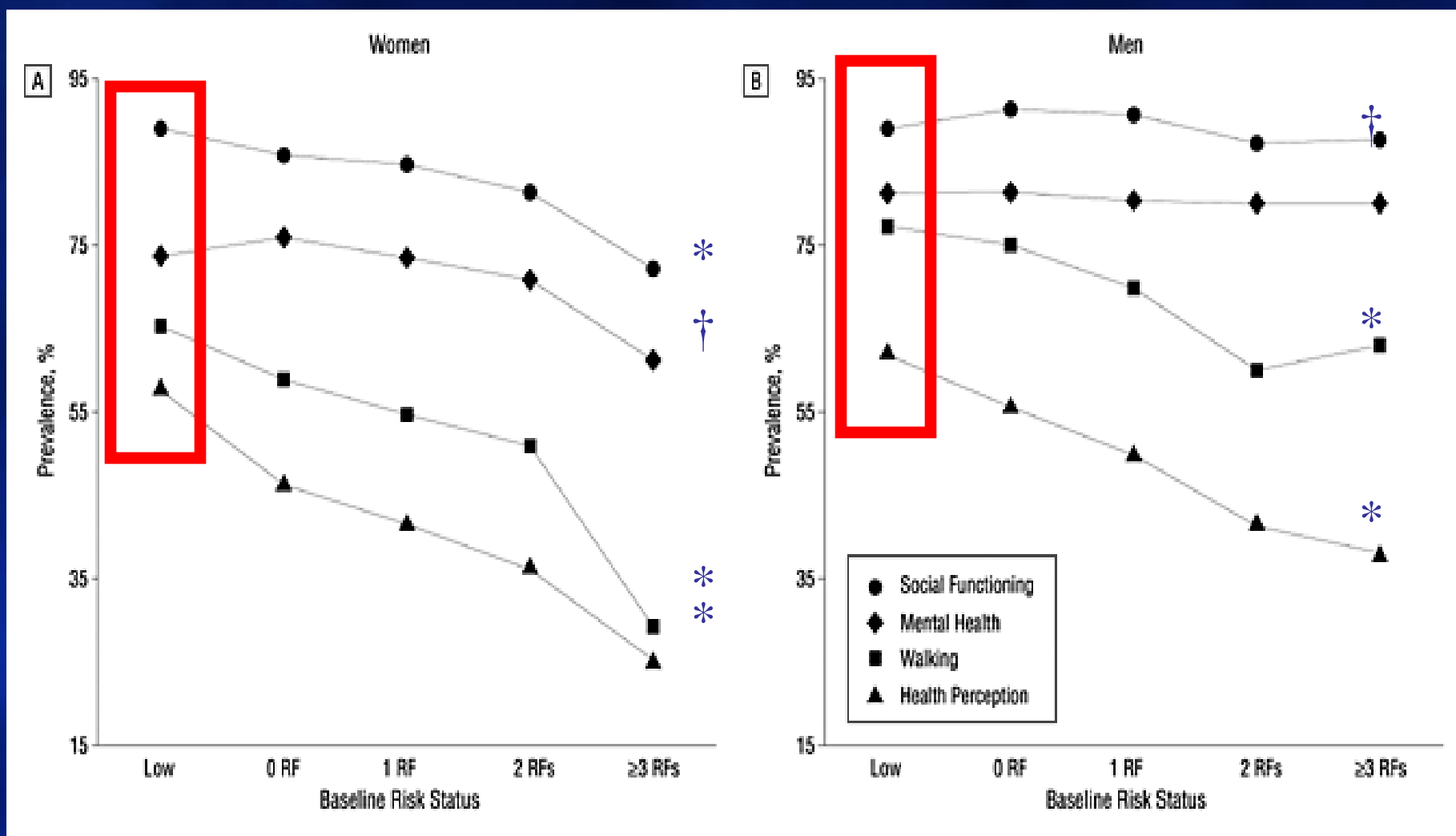
Mean age 73 after ~25 years f/u; *P trend <0.001; †P trend<0.05

Daviglus Arch Intern Med 2003

RF Burden in Middle Age and Adjusted Average Annual Medicare Charges (1994 US$)

No. of RFs	N	CVD $	Cancer $	Total $
Men - 0	279	760	447	3289
1	1560	1327*	446	3899
2	2729	1543*	518	4430
3	1057	2080*	888*	6068*
Women - 0	298	388	205	1817
1	1518	597*	315	3043*
2	2667	780*	359	3244*
3	924	1315*	395	4487*

*P<0.05

Daviglus N Engl J Med 1998

- Longitudinal study of lifestyle and evolution of CVD risk factors in young adults

- 5,115 black and white men and women, varying educational attainment

- Aged 18 – 30 at baseline (1985 – 1986)

- Four study centers: Chicago IL, Birmingham AL, Minneapolis MN, Oakland CA

- Follow-up examinations at years 2, 5, 7, 10, 15, 20, 25

Definition of Healthy Lifestyle Factors

Criteria at Year 0 and Year 7:

- Average BMI < 25 kg/m^2

- Alcohol intake: Women, 0 - ≤15g/day, Men, 0 - ≤30g/day

- Diet score: race-sex-specific highest 40% of the cohort on a composite measure based on a diet:

- <u>High</u> in Potassium, Calcium, and fiber

- <u>Low</u> in saturated fatty acids

- Average physical activity score ≥ 60th percentile by race and sex

- Never a cigarette smoker

Age-Adjusted Prevalence of Being Low Risk† at Y15 by Healthy Lifestyle Group
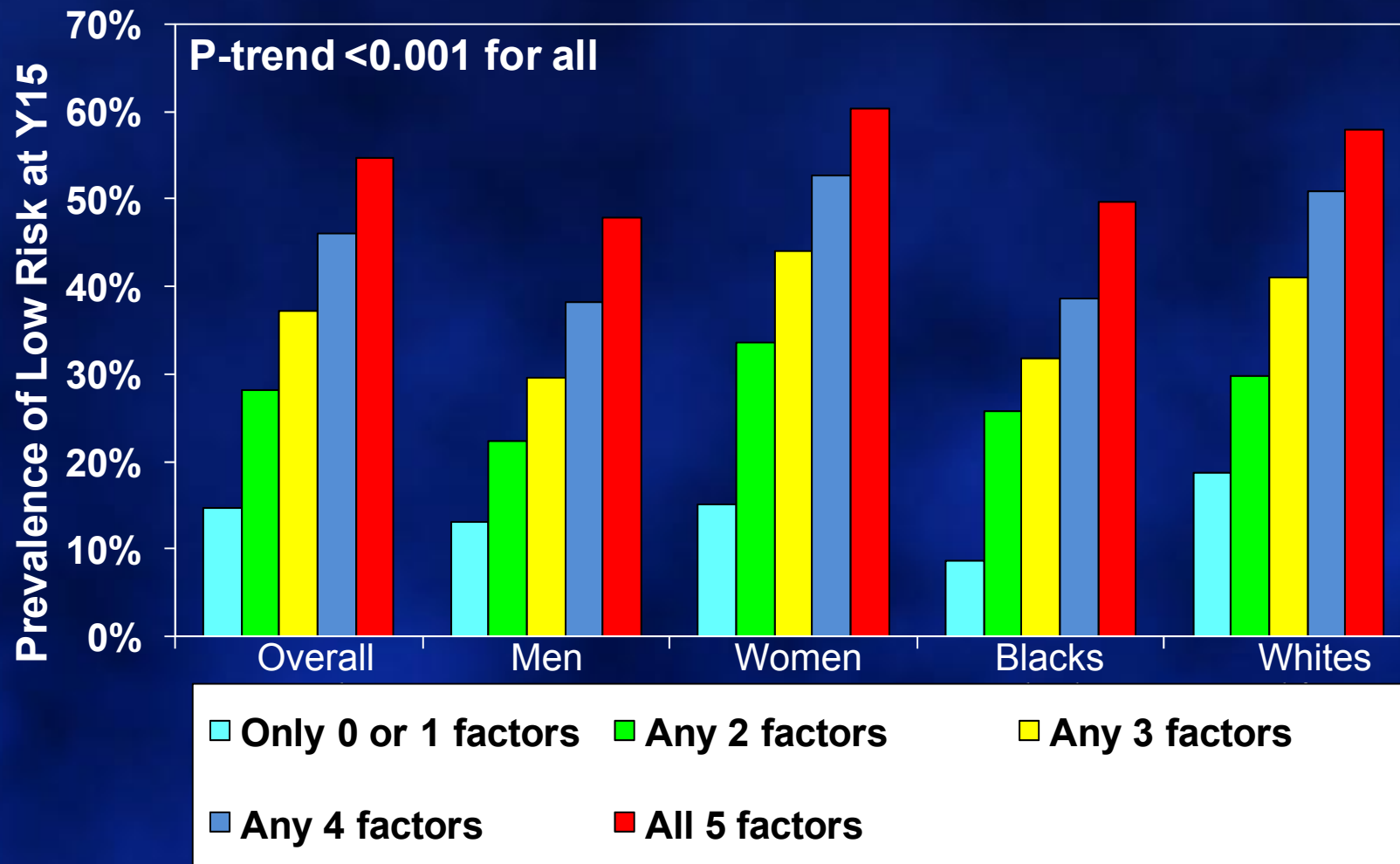
† Low Risk: BP < 120/80 mmHg, S. Cholesterol < 200mg/dl, no smoking, not on Rx for DM and no history of MI.

Nutrient Intake of Adults at Low Risk of Cardiovascular Disease: The International Study of Macro/Micro-nutrients and Blood Pressure (INTERMAP)

**CHRISTINA SHAY, ALAN DYER, IAN BROWN,
QUEENIE CHAN, PAUL ELLIOTT,
IOANNA TZOULAKI, NAGAKO OKUDA;
MARTHA DAVIGLUS, LINDA VAN HORN**
AND **JEREMIAH STAMLER**

FOR THE INTERMAP RESEARCH GROUP

The International Study of Macro/Micro-nutrients and Blood Pressure (INTERMAP), 1996-1999

- Participants
  - 4,680 men and women
  - Ages 40–59 years
  - Japan (4 samples), People's Republic of China (3 samples), United Kingdom (2 samples), and United States (8 samples)
  - Representative random samples from the general population and workforce
  - Stratified by age/gender with equally distributed groups

Study Aims and Hypotheses

- Study Aim: To examine nutrient intakes of LR and non-LR individuals

- Hypothesis: Lower intake of "adverse" and higher intake of "favorable" nutrients are associated with being LR

The International Study of Macro/Micro-nutrients and Blood Pressure (INTERMAP), 1996-1999

- Measurements

  ○ Two in-depth 24-h dietary recalls – 83 nutrients via the in-depth multipass 24-h recall method

  ○ Two 24-h urine collections

  ○ Demographic characteristics, medical history, physical activity, medication use, daily alcohol consumption over the previous 7 days by interviewer-administered questionnaire

INTERMAP Definition of Low Risk

- Each of the following criteria must be met

  - Untreated systolic BP ≤ 120 mmHg <u>and</u> diastolic BP ≤ 80 mmHg

  - BMI < 25.0 kg/m² (Western Regions), < 23.0 kg/m² (Eastern Regions)

  - Not a current smoker

  - No history of (or medication use for) diabetes, CHD, stroke

  - No excessive drinking (< 26 g/day (men) or < 13 g/day (women))

Statistical Analyses

- For nutrients supplying energy, intake was calculated as % kcal; for others, as intake/1,000 kcal

- Total protein intake calculated as % kcal and individual protein sources as % total protein

- Urinary values calculated as products of urinary concentrations and timed volume standardized to 24-h

- Logistic regression analyses - to assess association of individual nutrient intakes with LR

Participant Characteristics

	Not Low Risk	Low Risk	p
Number (n, %)	3923 (84)	757 (16)	
Age (years)	49.4 (5.4)	48.1 (5.5)	<0.001
Male Gender (%)	55	26	<0.001
Education (years)	12.3 (4.4)	12.1 (4.9)	0.28
SBP (mmHg)	121.3 (14.6)	106.7 (7.3)	
DBP(mmHg)	75.4 (9.9)	66.0 (6.2)	
BMI (kg/m^2)	27.3 (5.5)	21.7 (1.8)	
Family Hx of Hypertension (%)	57	42	<0.001
Supplement Use (%)	34	39	0.02
Physical Activity (hours/day) median (IQR)	2.0 (0.5-6.0)	2.0 (0.5-7.0)	0.16
Special diet (%)	14	10	<0.001

Odds ratios[a] for relation of individual micro-nutrient intakes to low risk
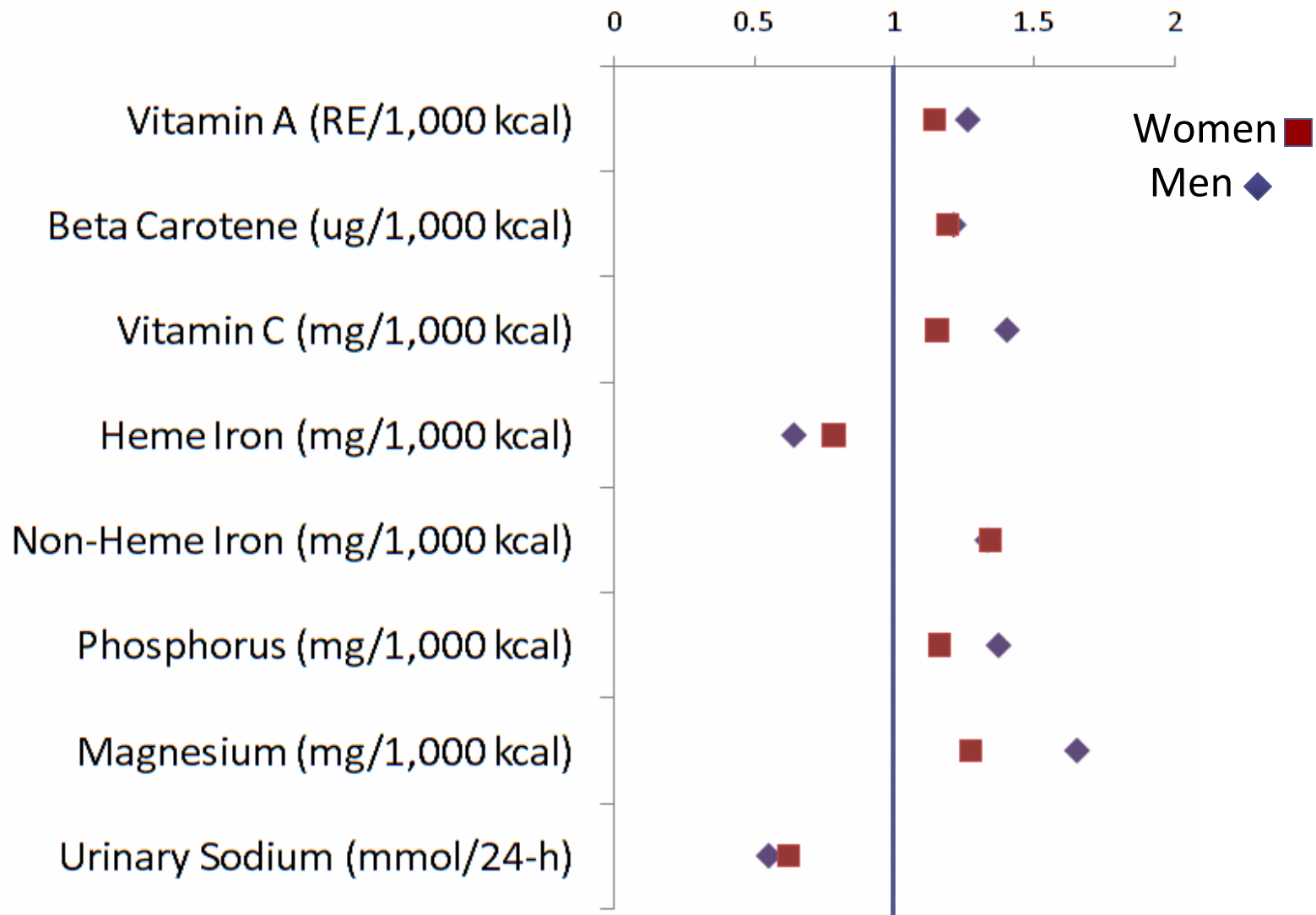
[a]Odds ratios are presented for each nutrient higher by 1 standard deviation
Model adjusted for age, sample, special diet (yes/no), supplement use (yes/no),
moderate/heavy physical activity (hours/day); all nutrients significantly associated with low risk, p<0.05

Odds ratios[a] for relation of individual macro-nutrient intakes to low risk
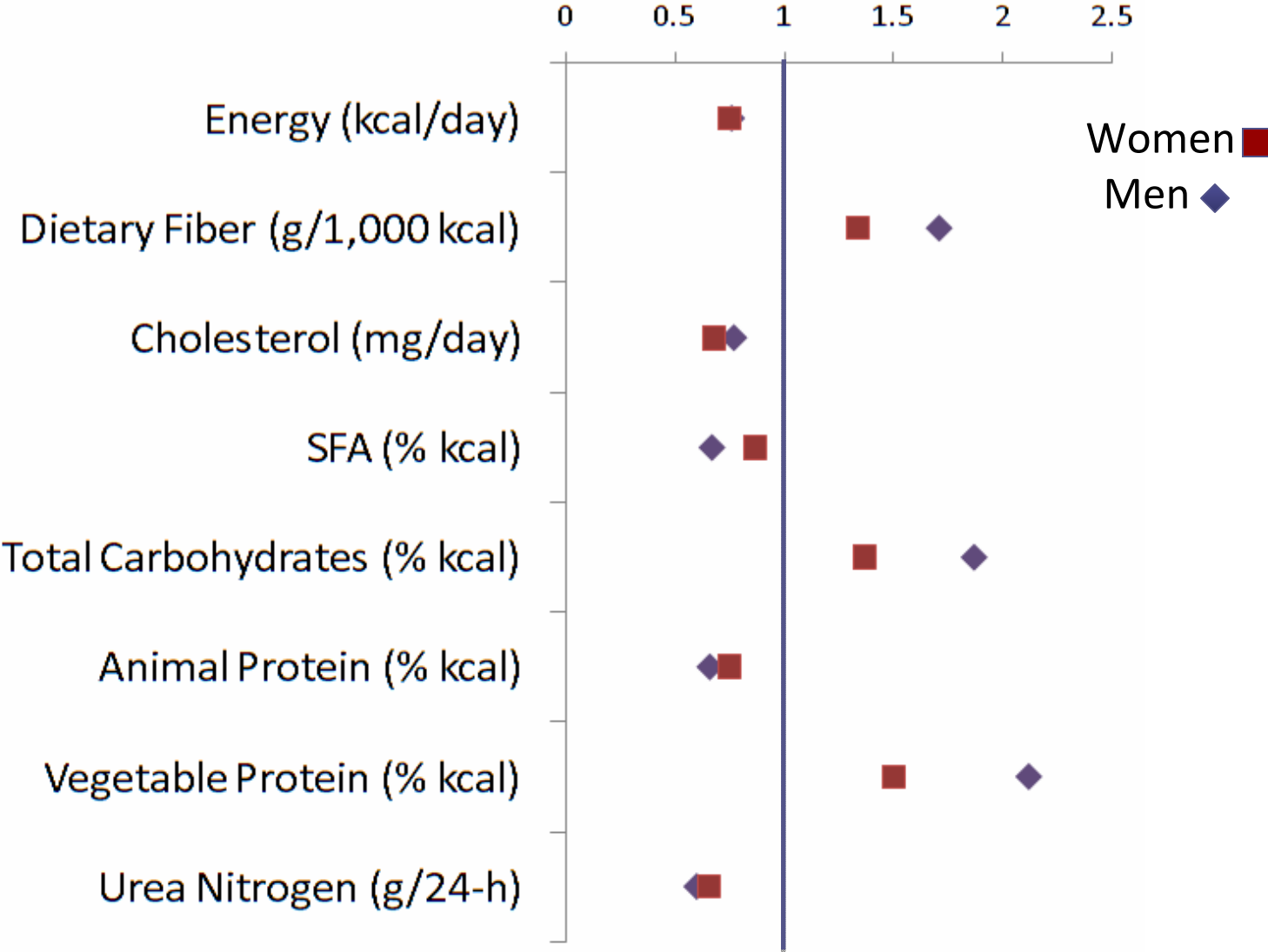
Women ■
Men ◆

[a]Odds ratios are presented for each nutrient higher by 1 standard deviation
Model adjusted for age, sample, special diet (yes/no), supplement use (yes/no),
moderate/heavy physical activity (hours/day); all nutrients significantly associated with low risk, $p<0.05$

Strengths and Limitations

- **STRENGTHS**
  - Dietary intake was examined using INTERMAP high-quality, standardized, extensive macro- and micro-nutrient data from 17 diverse population samples in four countries (East Asian and Western)

- **LIMITATIONS**
  - Cross-sectional design; definition of LR for this investigation was based on available INTERMAP measures (not including blood samples)

Application of Current Findings

- Multiple specific nutrient intakes are associated with low CVD risk

- The nutrient intake pattern of LR individuals is consistent with many eating styles recommended for the reduction of CVD risk

- Low-sodium DASH-style diet

- OMNI-Heart Trial diet

- Heart-Healthy diet (American Heart Association)

- Mediterranean Diet for the 21st Century

2020 Strategic Impact Goals

AHA Special Report

Defining and Setting National Goals for Cardiovascular Health Promotion and Disease Reduction
The American Heart Association's Strategic Impact Goal Through 2020 and Beyond

Donald M. Lloyd-Jones, MD, ScM, FAHA, Chair;
Yuling Hong, MD, MSc, PhD, FAHA*; Darwin Labarthe, MD, MPH, PhD, FAHA*;
Dariush Mozaffarian, MD, DrPH, FAHA; Lawrence J. Appel, MD, MPH, FAHA;
Linda Van Horn, PhD, RD, FAHA; Kurt Greenlund, PhD*; Stephen Daniels, MD, PhD, FAHA;
Graham Nichol, MD, MPH, FAHA; Gordon F. Tomaselli, MD, PhD, FAHA; Donna K. Arnett, PhD, FAHA;
Gregg C. Fonarow, MD, FAHA; P. Michael Ho, MD, PhD; Michael S. Lauer, MD, FAHA;
Frederick A. Masoudi, MD, MPH; Rose Marie Robertson, MD, FAHA; Véronique Roger, MD, FAHA;
Lee H. Schwamm, MD, FAHA; Paul Sorlie, PhD; Clyde W. Yancy, MD, FAHA;
Wayne D. Rosamond, PhD, FAHA; on behalf of the American Heart Association Strategic Planning Task Force
and Statistics Committee

CV Health Factors Definitions - Adults

	Health Category		
Metric	Poor	Intermediate	Ideal
Current Smoking	Yes	Former, Quit <12 months	Never or Quit ≥12 months
Total Cholesterol	≥240	200-239 or treated to goal	<200
Blood Pressure	SBP ≥140 or DBP ≥90	SBP 120-139 or DBP 80-89 or treated to goal	<120/<80
Fasting Glucose	≥126	100-125, or DM treated to goal	<100

CV Health Behaviors Definitions - Adults

Metric	Health Category		
	Poor	Intermediate	Ideal
Current Smoking	Yes	Former, <12 months	Never or Quit ≥12 months
Body Mass Index (kg/m^2)	≥30	25-29.9	<25
Physical Activity	None	1-149 mins/wk moderate or 1-74 mins/wk vigorous	150+ mins/week moderate or 75+ mins/wk vigorous
Healthy Diet Score*	0-1 Factors	2-3 Factors	4-5 Factors

*Healthy Diet Score based on adherence to the following practical recommendations for dietary intake: fruits and vegetables≥ 4.5 cup serv/day, fish≥2 3.5 oz serv/week, sodium≤1500 mg/day, sugar-sweetened beverages≤450 kcal (36 oz) per week, and whole grains≥3serv/day

Ideal Cardiovascular Health

AHA 2020 Strategic Impact Goals

Defined by the simultaneous presence of all 7 ideal CV health behaviors and CV health factors

Northwestern University Feinberg School of Medicine

Prevalence of Ideal Cardiovascular Health in Adults: Findings from the National Health and Nutrition Examination Survey (2003-2008)

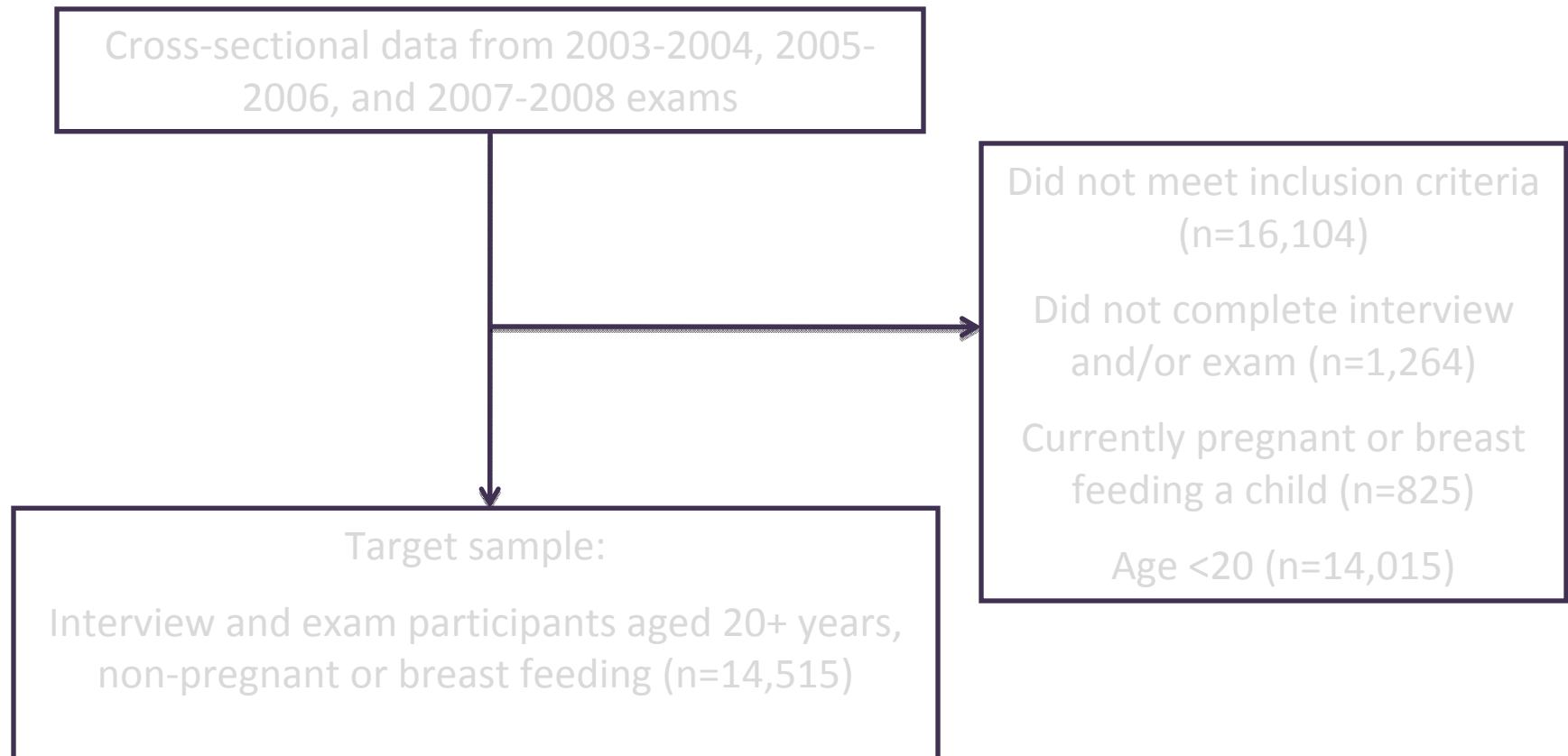**Christina Shay**, Hongyan Ning, Norrina Allen, Mercedes Carnethon, Kurt Greenlund, Martha Daviglus, Donald Lloyd-Jones

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Study Objective

- To detail age- and sex- specific prevalence estimates for U.S. adults having 0-7 ideal CV health components

- To present age- and sex-specific prevalence estimates of individual CV health components for U.S. adults according to poor, intermediate, ideal classification

National Health and Nutrition Examination Surveys (NHANES)

Cross-sectional data from 2003-2004, 2005-2006, and 2007-2008 exams

Did not meet inclusion criteria (n=16,104)

Did not complete interview and/or exam (n=1,264)

Currently pregnant or breast feeding a child (n=825)

Age <20 (n=14,015)

Target sample:

Interview and exam participants aged 20+ years, non-pregnant or breast feeding (n=14,515)

- Clinical/lifestyle data collected via standardized NHANES in-home and mobile examination center protocols

Number of Ideal CV Health Components in U.S. MEN: NHANES 2003-2008
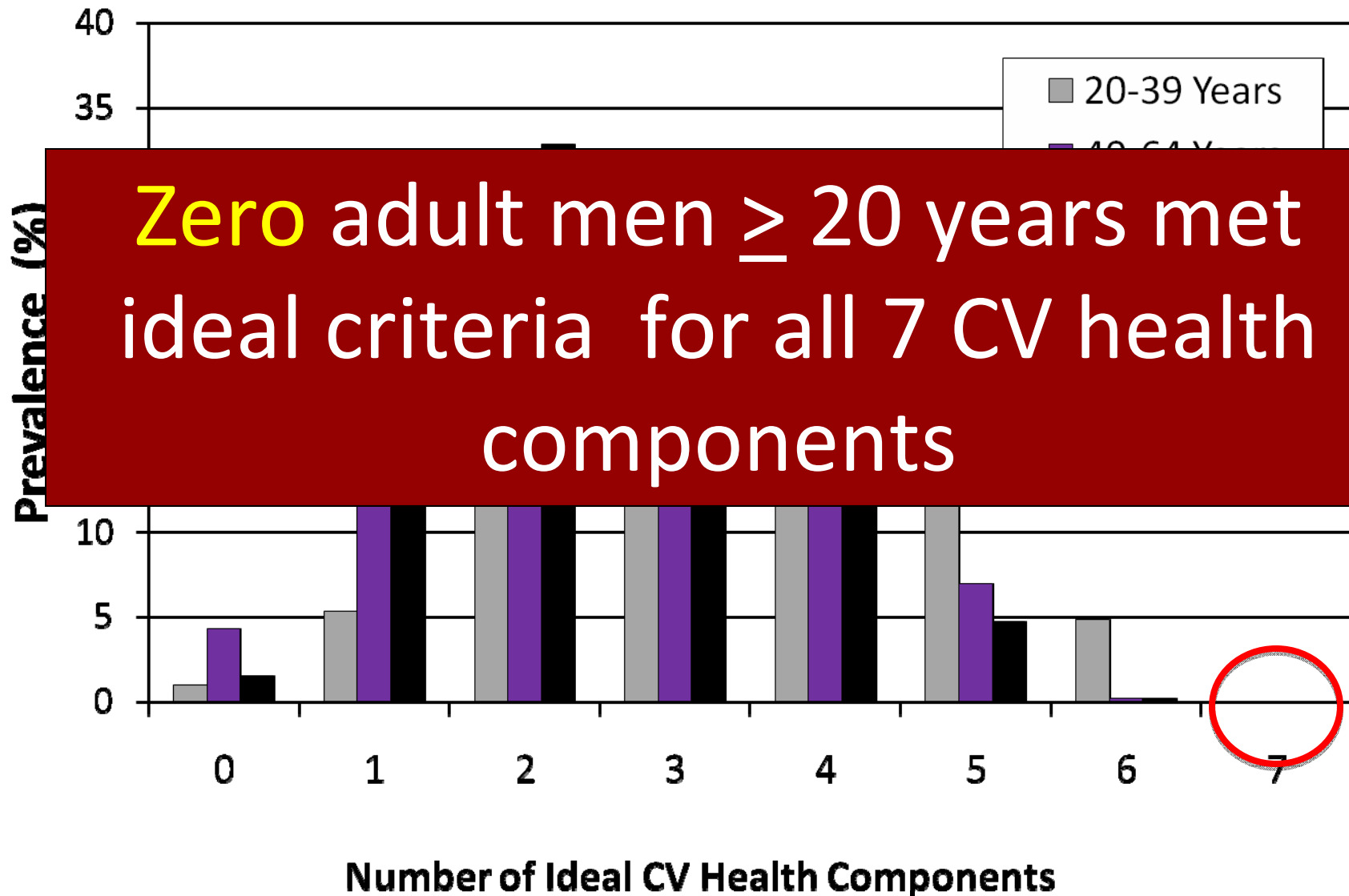
Zero adult men ≥ 20 years met ideal criteria for all 7 CV health components

Number of Ideal CV Health Components in U.S. WOMEN: NHANES 2003-2008

Less than 1% of all adult women $\geq$ 20 years met ideal criteria for all 7 CV health components
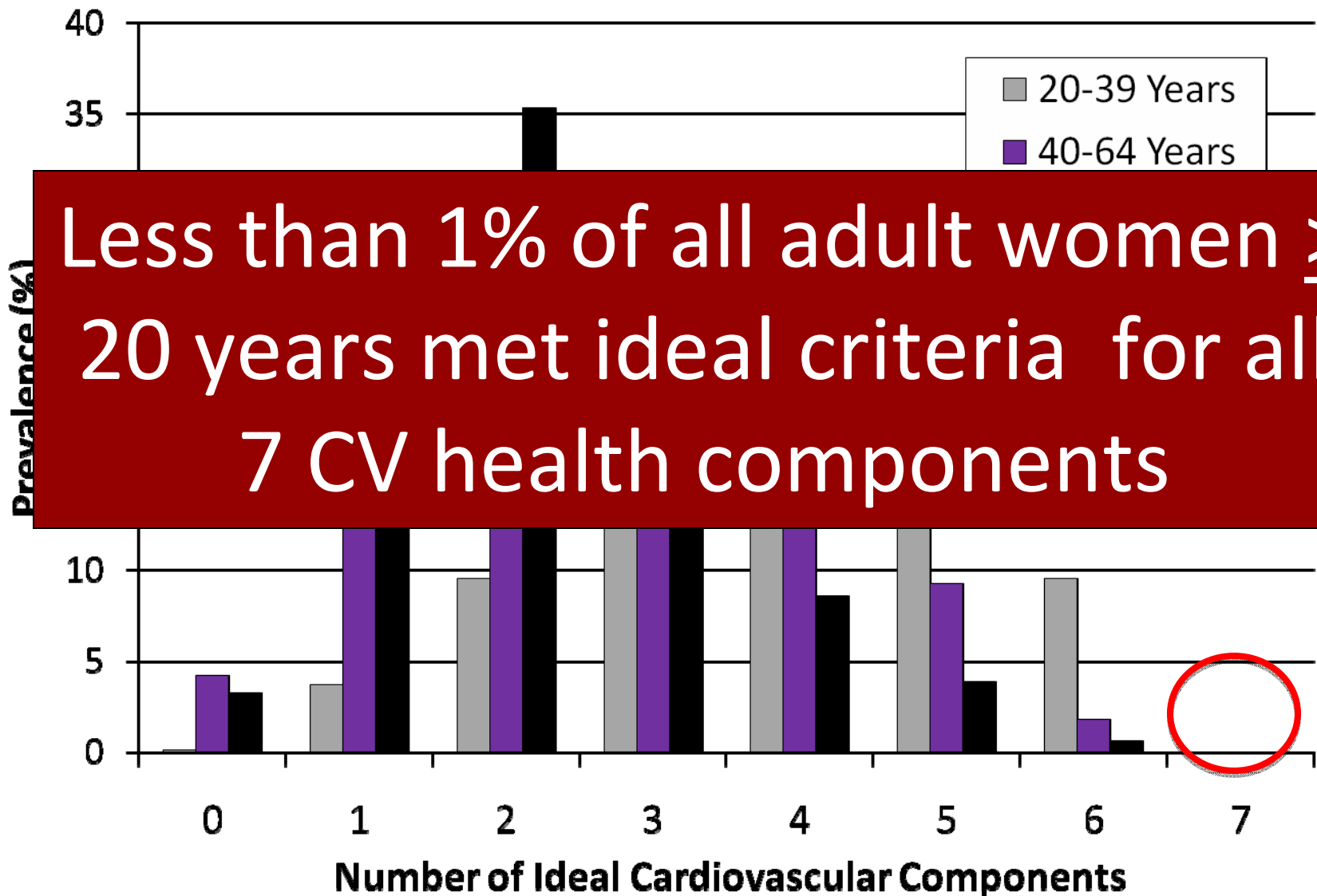
Cardiovascular Health Behaviors

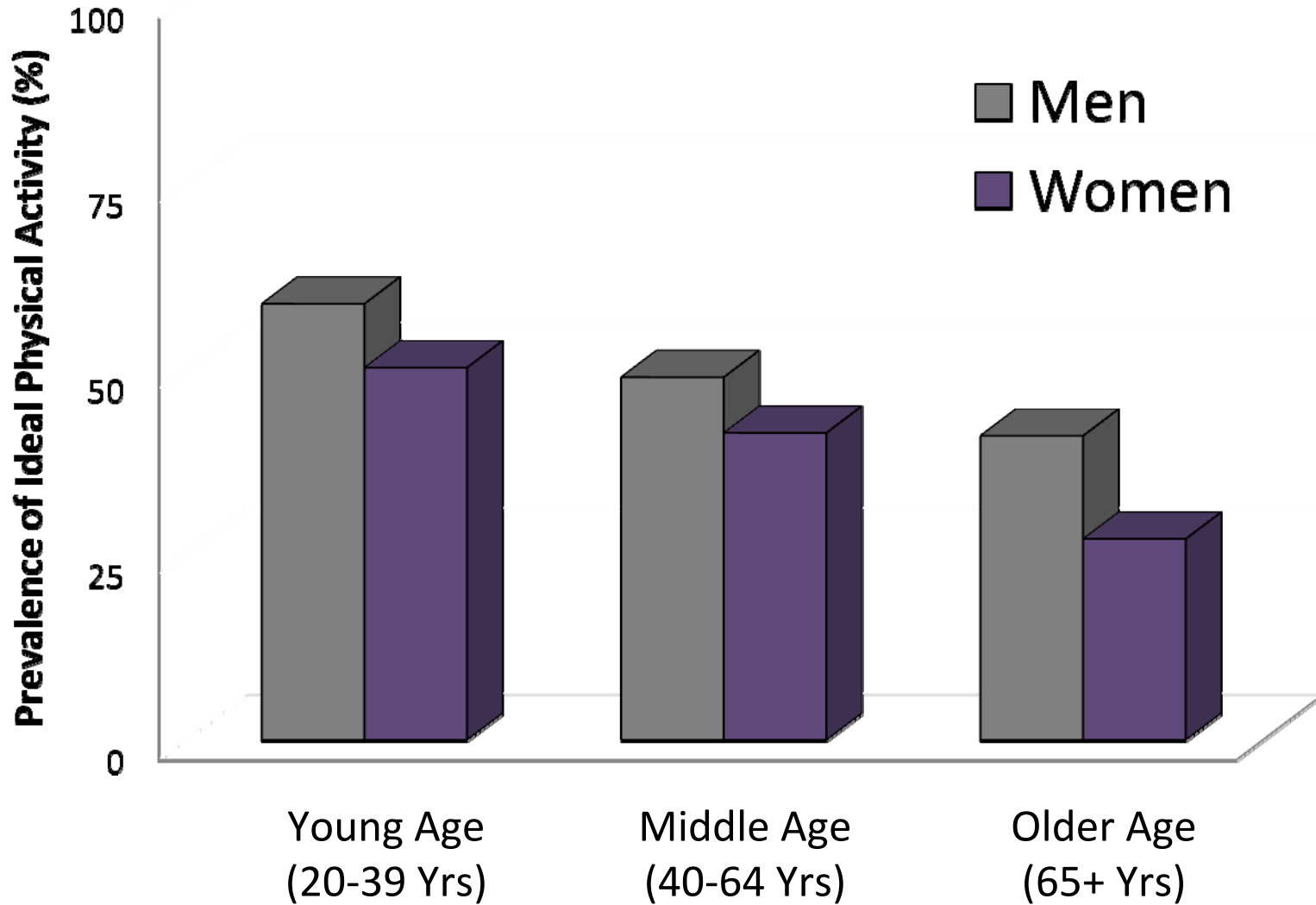# Prevalence of Ideal Smoking Status* by Sex and Age Group NHANES 2003-2008
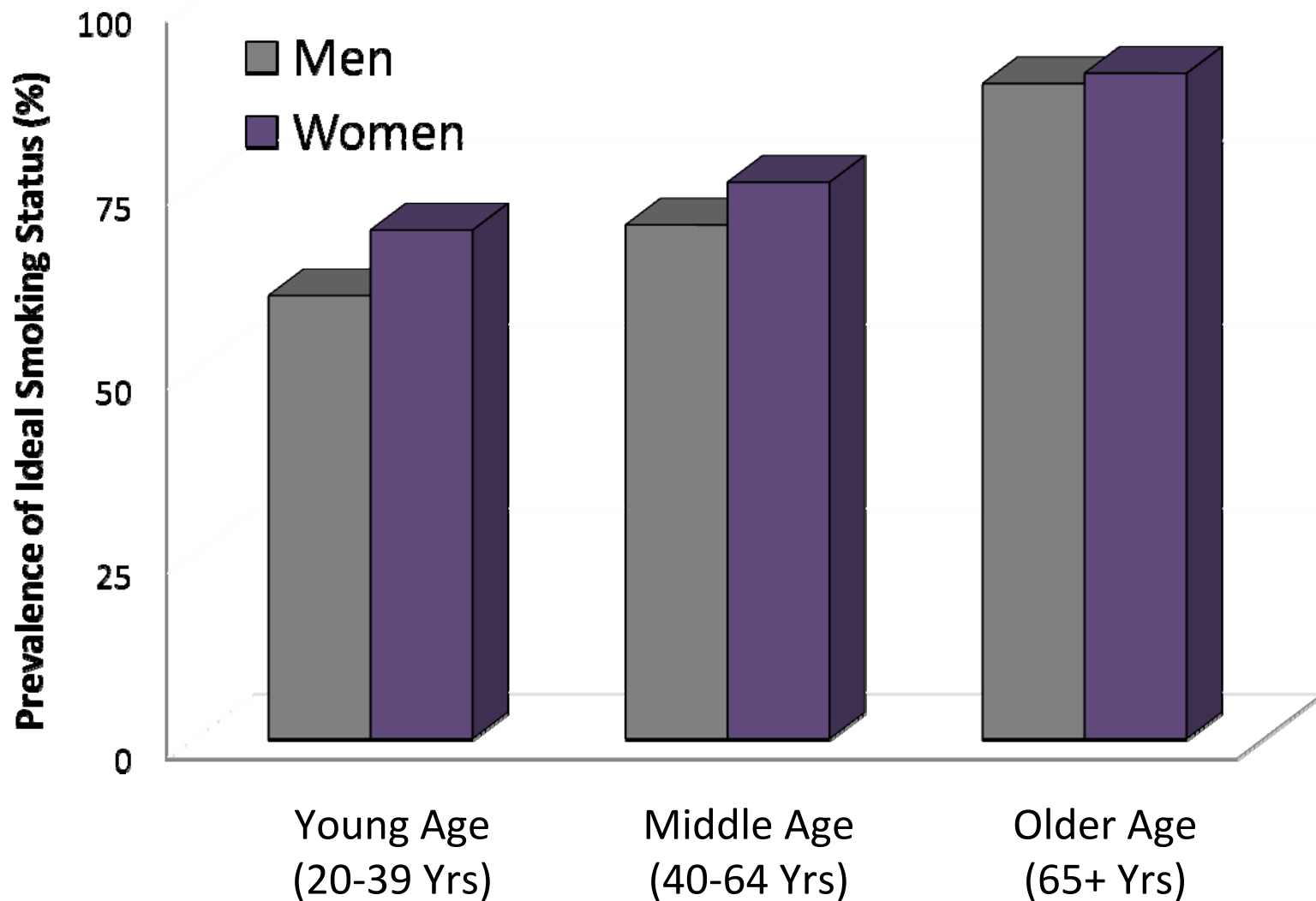
*Ideal Smoking Status defined as Never or Quit > 12 mo.

Prevalence of Ideal Body Mass Index* by Sex and Age Group NHANES 2003-2008
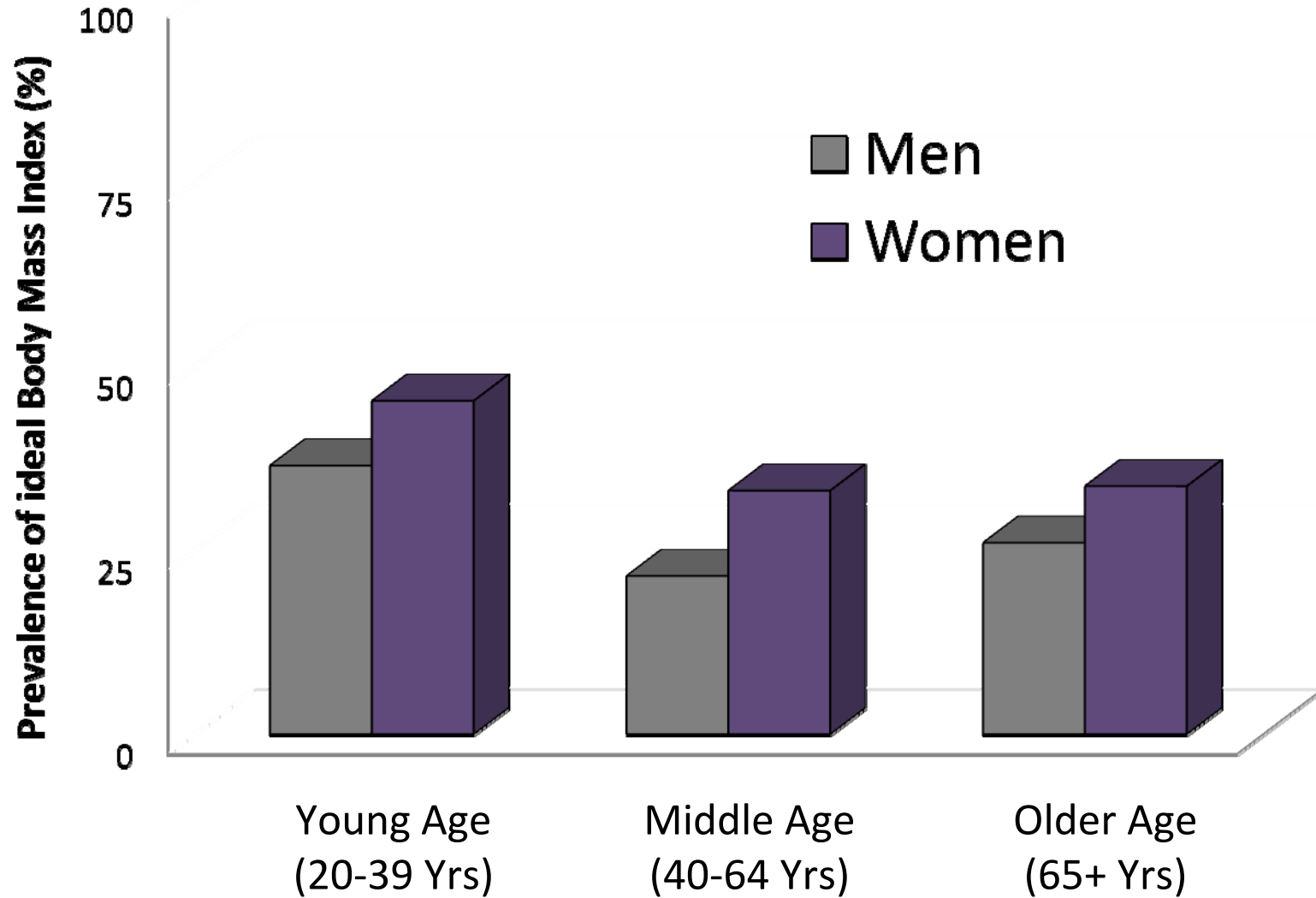
*Ideal Body Mass Index defined as < 25.0 kg/m^2

Prevalence of Ideal Physical Activity* by Sex and Age Group NHANES 2003-2008

*Ideal Physical Activity defined as 150+ mins/week moderate or 75+ mins/wk vigorous or 150+ mins/week moderate+2X vigorous
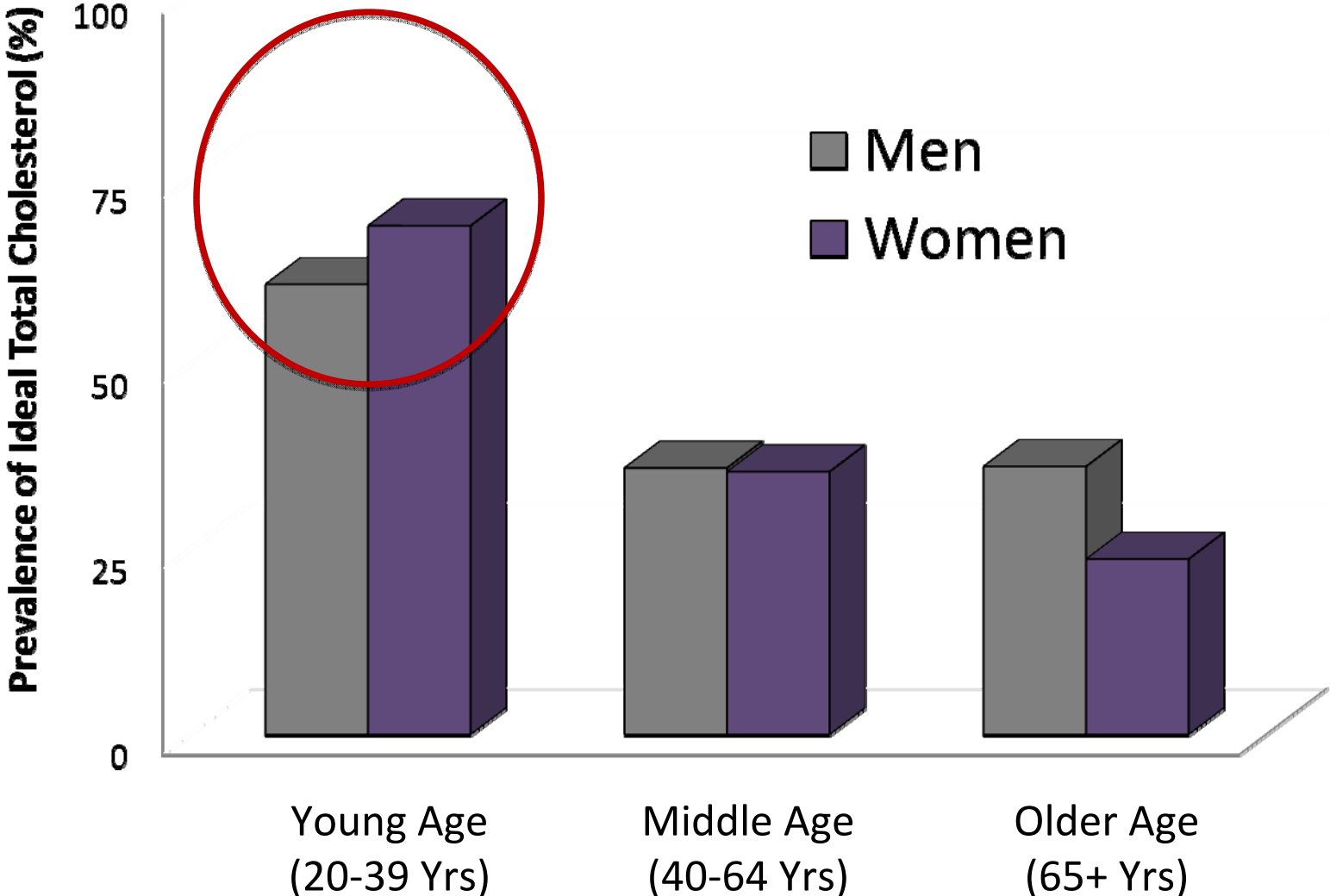
Prevalence of Ideal Healthy Diet Score* by Sex and Age Group NHANES 2003-2008
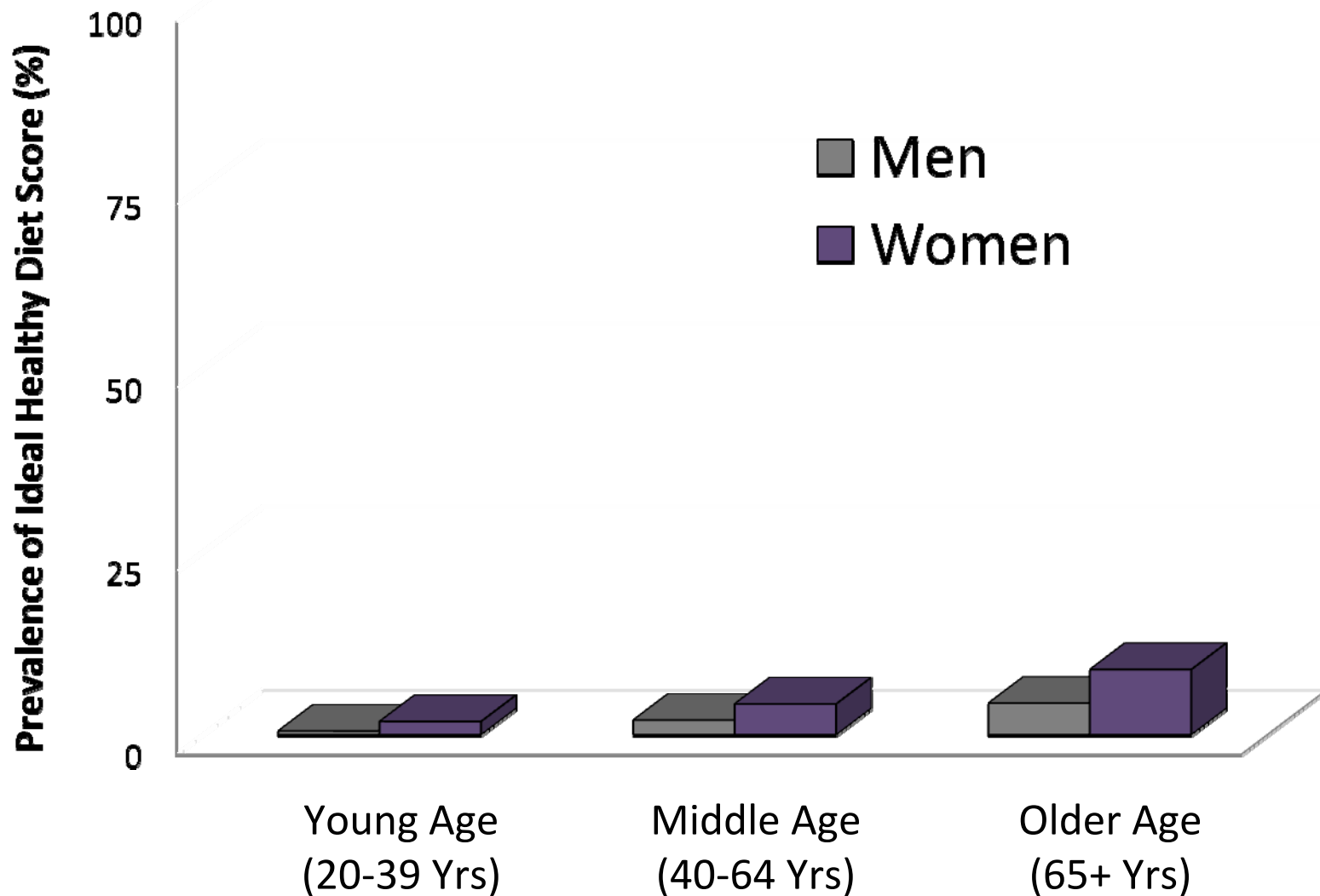
Ideal Healthy Diet Score defined as ideal intake of 4-5 practical dietary recommendations (Fruits and vegetables, whole grains, fish, sodium, and sugar-sweetened beverages)
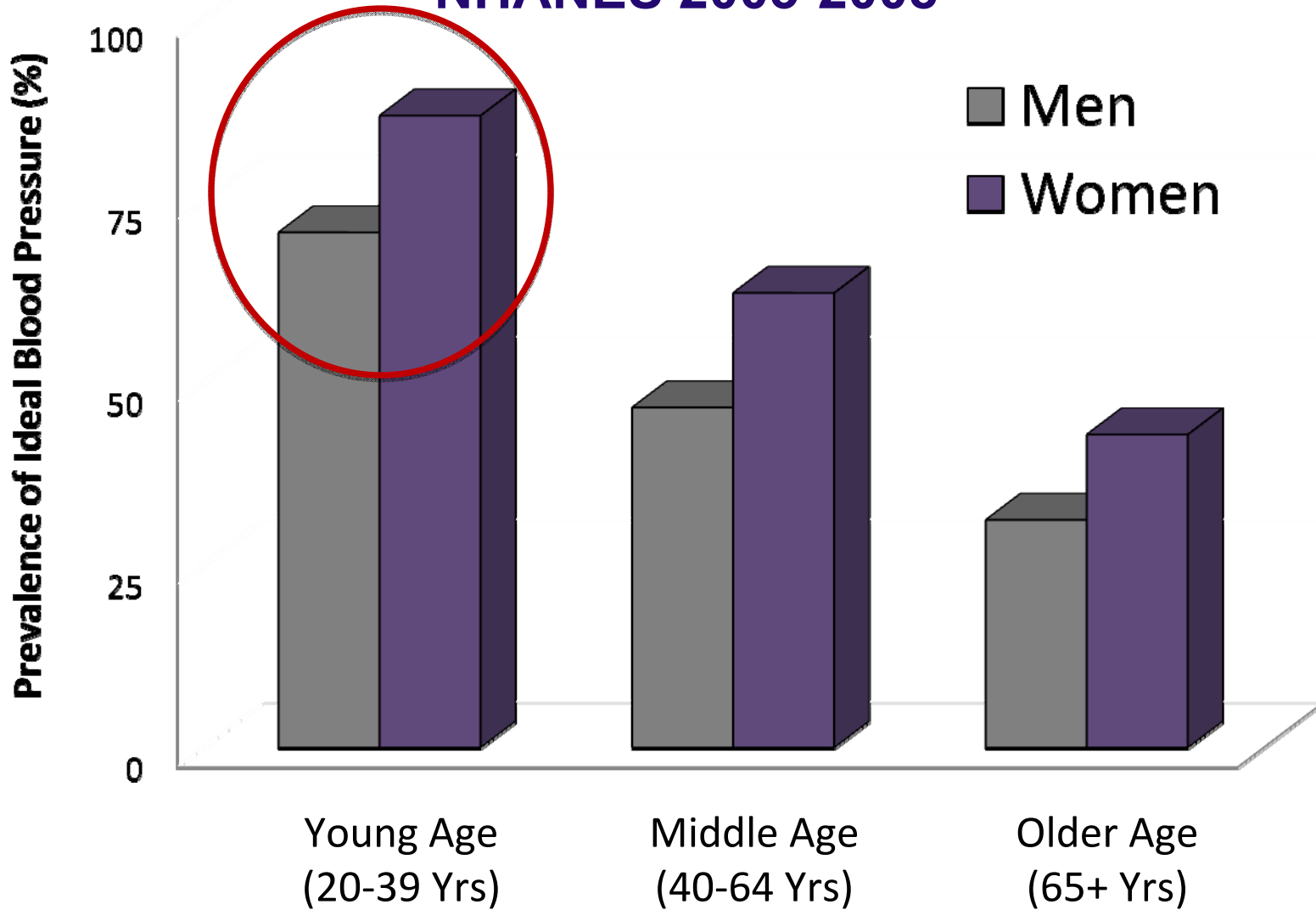
Cardiovascular Health Factors

Prevalence of Ideal Total Cholesterol by Sex and Age Group
NHANES 2003-2008

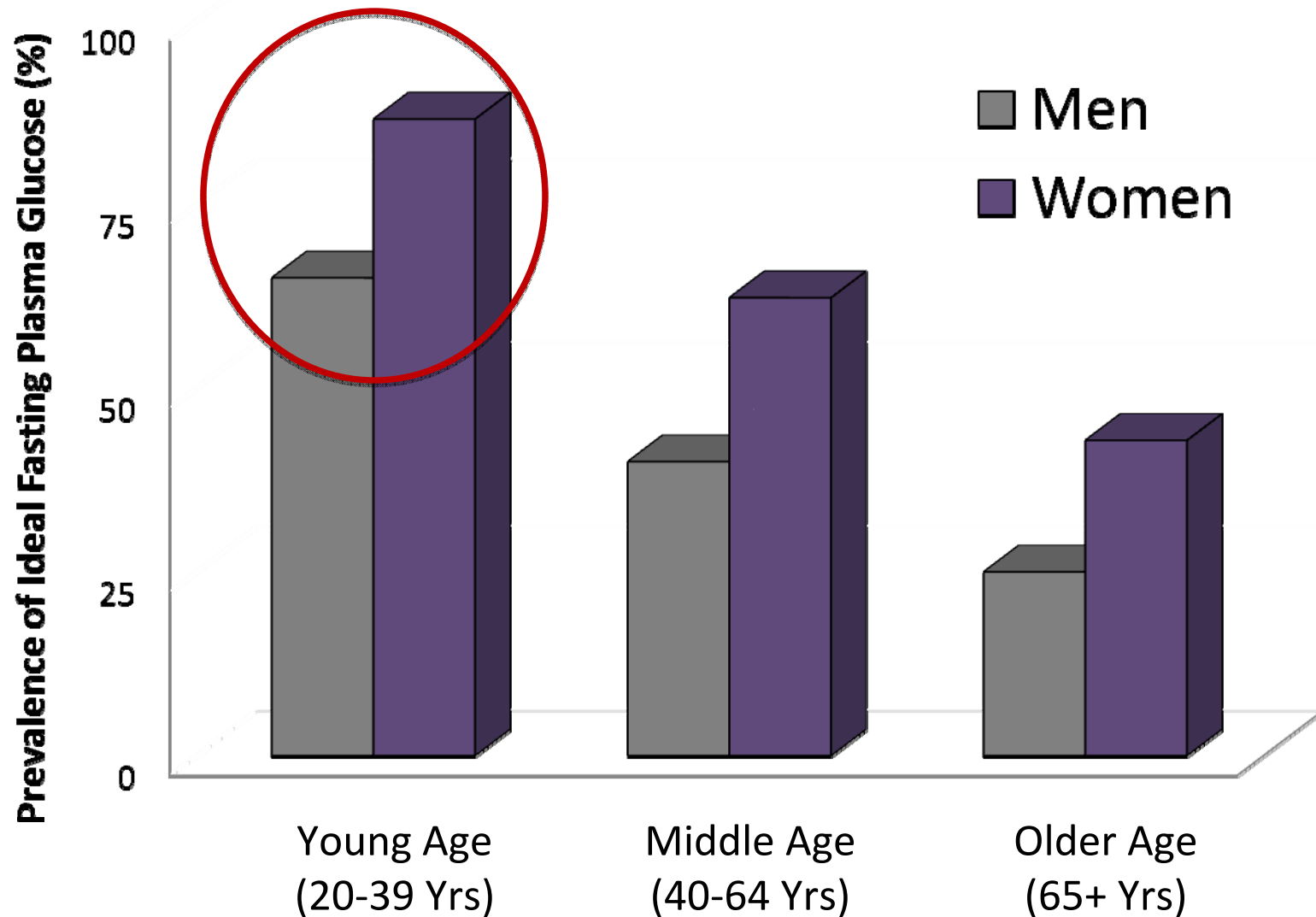Ideal total cholesterol defined as untreated total cholesterol < 200 mg/dL

Prevalence of Ideal Blood Pressure by Sex and Age Group NHANES 2003-2008

Ideal blood pressure defined as untreated SBP < 120 mm/Hg and DBP < 80

Prevalence of Ideal Fasting Plasma Glucose by Sex and Age Group: NHANES 2003-2008

Ideal fasting plasma glucose defined as < 100 mg/dL, untreated

Summary and Conclusions

- Less than 1% of all U.S. adults are classified as having overall ideal CV health

- Low prevalence of ideal CV health factors (i.e. BP, TC, FPG) proportional to low prevalence of ideal CV behaviors (physical activity, diet, obesity)

- Population-based intervention efforts to reduce obesity (through lifestyle modification) likely to be an effective approach – particularly in young adults

Northwestern University Feinberg School of Medicine

Association of Health Behaviors with Ideal Cardiovascular Health Factors in Adults: Findings from the National Health and Nutrition Examination Survey (2003-2008)
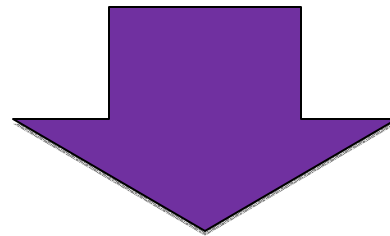
Christina Shay, Norrina Allen, Mercedes Carnethon, Hongyan Ning, Kurt Greenlund, Martha Daviglus, Donald Lloyd-Jones

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Study Objective

To investigate the association between individual CV health behaviors with the presence of low CVD risk

Low CVD risk → AHA Ideal CV health factors

CV health behaviors → AHA Ideal CV health behaviors

To examine whether these associations are similar across age groups (young, middle, and older age)

Low CVD Risk → Having All Ideal CV Health Factors

Each of the following criteria must be met:

- Systolic BP <120 mmHg <u>and</u> diastolic BP < 80 mmHg

- Total Cholesterol < 200 mg/dL

- No history of diabetes, CHD, stroke

- No drug treatment for hypertension, hyperlipidemia, diabetes, or CVD

CV Health Behaviors Definitions - Adults

Metric	Health Category		
	Poor	Intermediate	Ideal
Current Smoking	Yes	Former, <12 months	Never or Quit ≥12 months
Body Mass Index	≥30	25-29.9	<25
Physical Activity	None	1-149 mins/wk moderate or 1-74 mins/wk vigorous	150+ mins/week moderate or 75+ mins/wk vigorous
Healthy Eating Index (Age-Specific Tertile)	Low	Moderate	High

Prevalence of Low CVD Risk (All Ideal CV Health Factors) by Age Group: NHANES 2003-2008
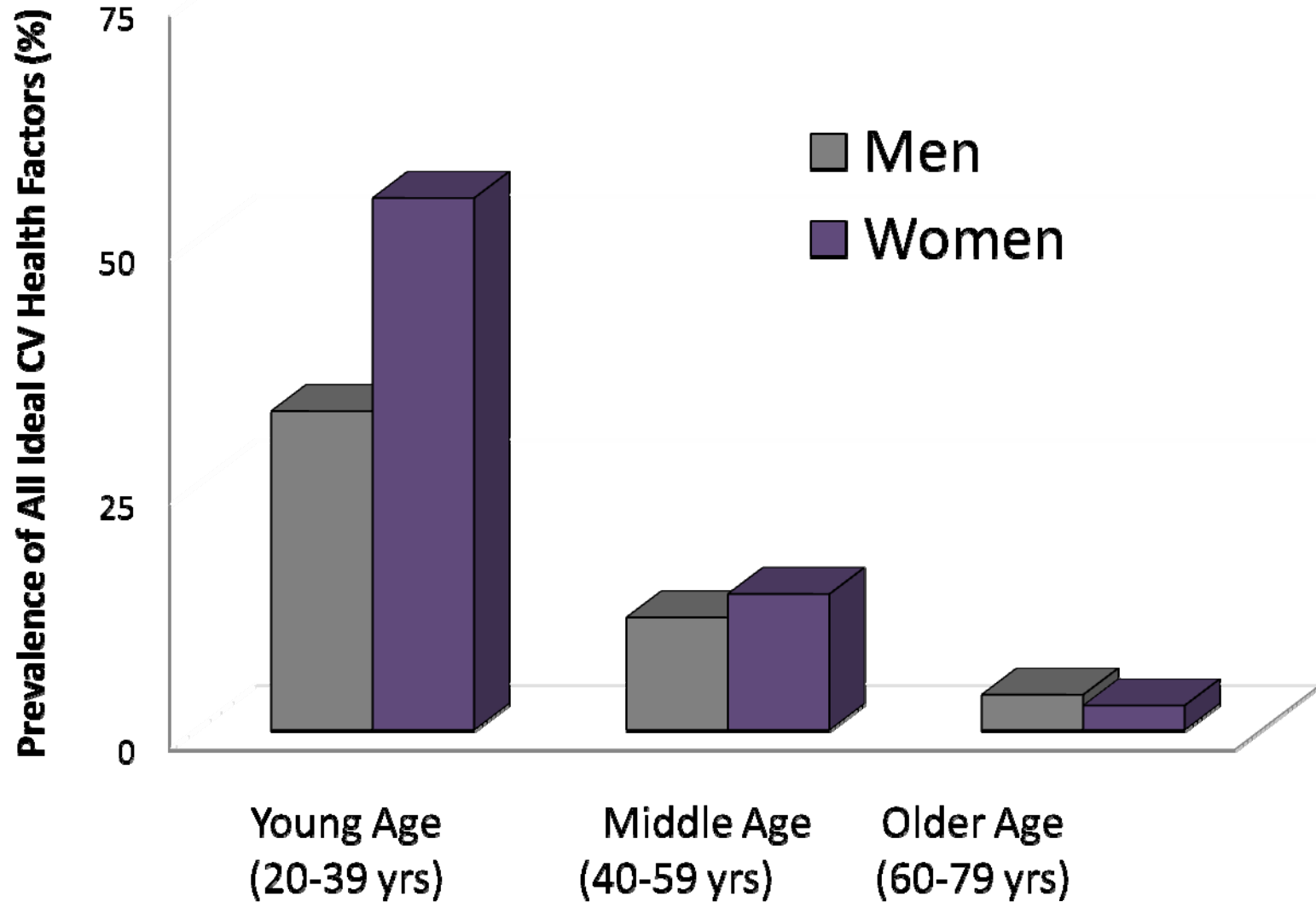
CV Health Factors include ideal untreated systolic and diastolic blood pressure, total cholesterol, and no history of CVD, stroke, or diabetes

Participant Characteristics by Age Group and Low CVD Risk Status: NHANES (2003-2008)

|	Young Age (20-39 yr)		Middle Age (40-64 yr)		Older Age (65+ yr)	
	Not LR	LR	Not LR	LR	Not LR	LR
Age (years)	30.8	**28.4***	51.1	**47.0***	73.8	**72.1***
White (Non-Hispanic) (%)	63.9	64.8	74.6	75.4	83.7	86.2
Education (> high school) (%)	56.1	**60.8***	59.0	**64.6 ***	41.4	**45.8 ***
Income (≥ $45,000/yr) (%)	51.3	51.0	58.7	60.0	30.4	**34.3***

Significantly different than Not LR within age group, p < 0.05

Odds Ratio* (95% C.I.) for Association of CV Health Behaviors with Low CVD Risk in Young Age (20-39 yr): NHANES 2003-2008
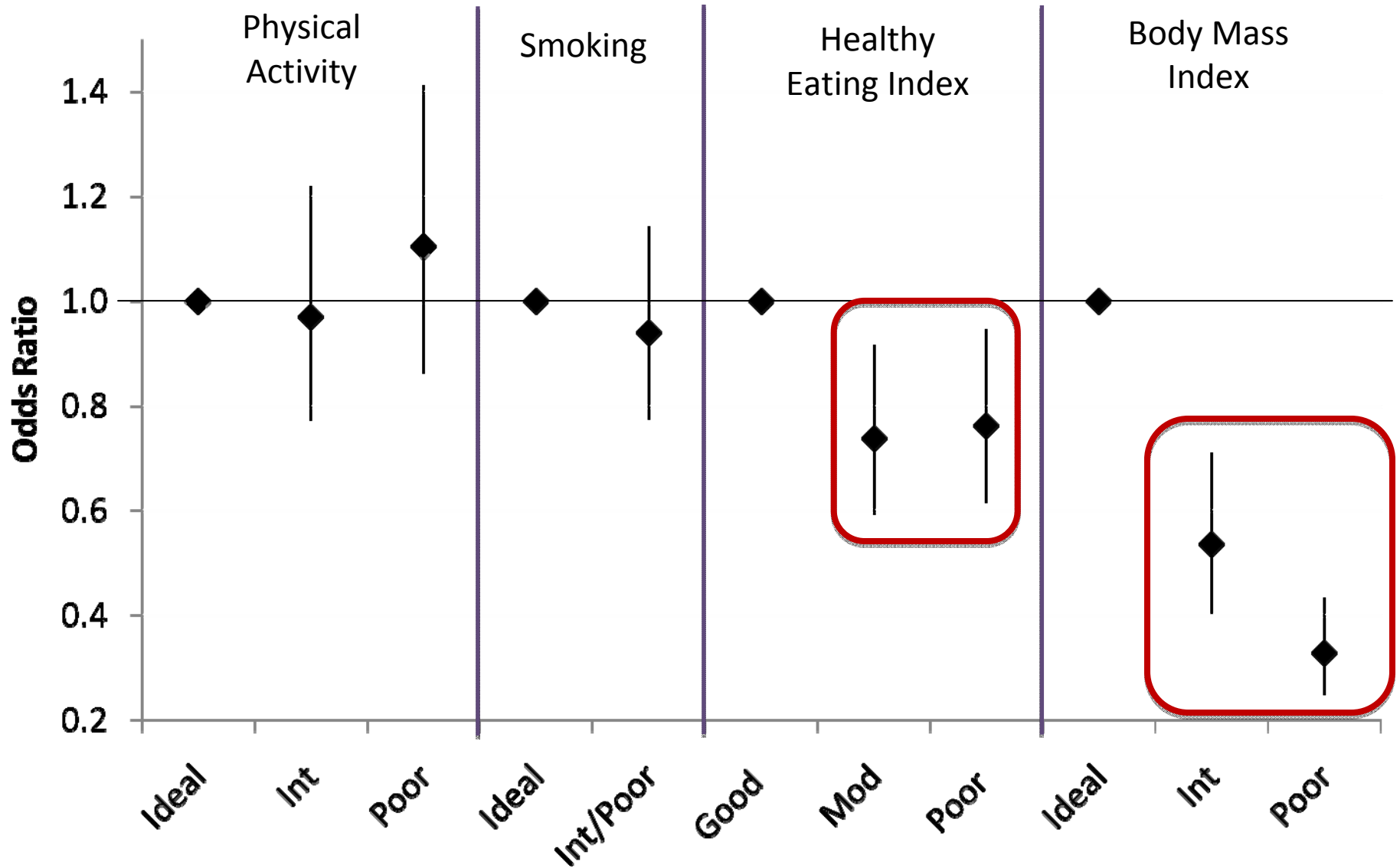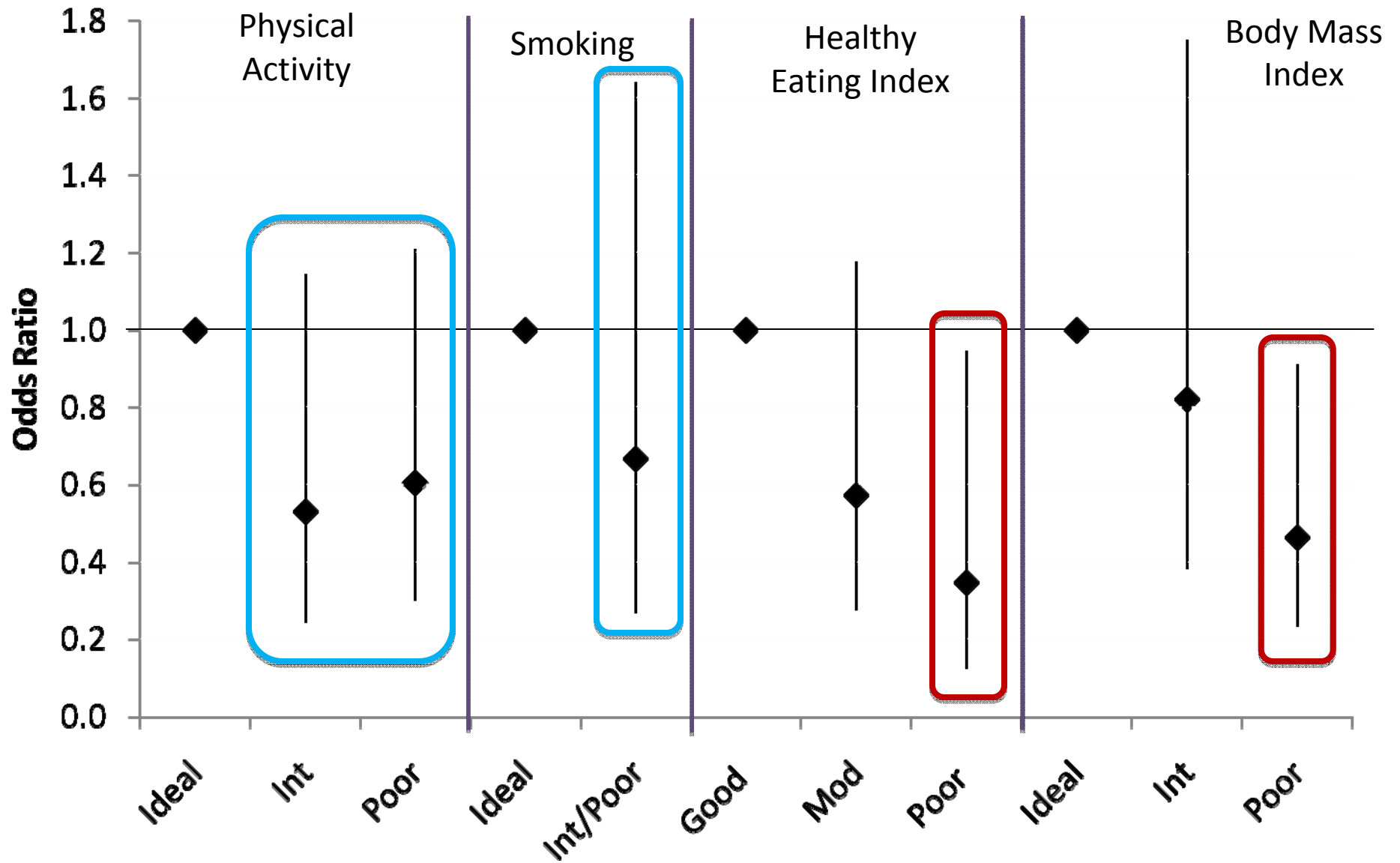
*All models adjusted for age, sex, education, and income

Odds Ratio (95% C.I.) for Association of CV Health Behaviors with Low CVD Risk in Middle Age (40-64 yr): NHANES 2003-2008
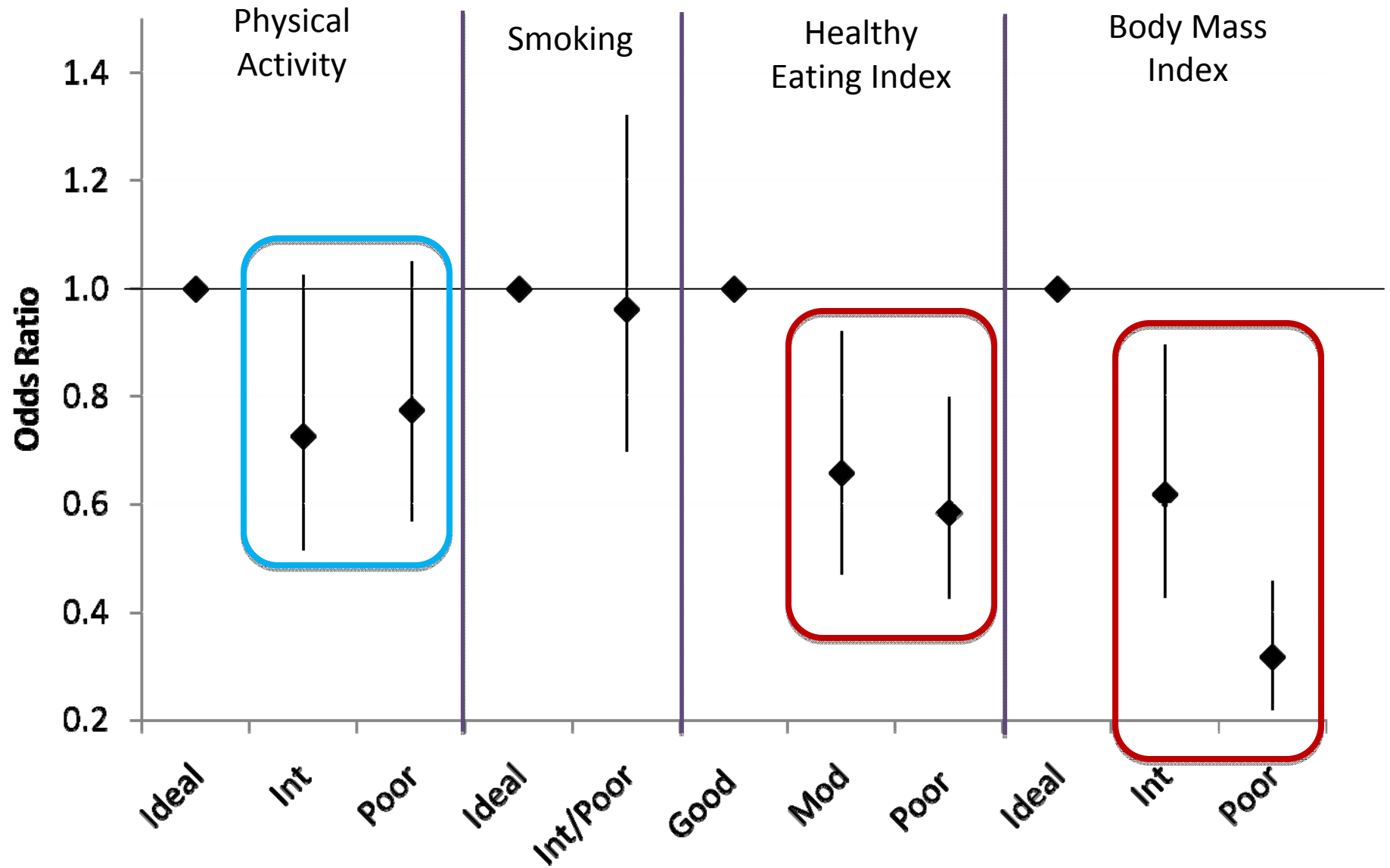
*All models adjusted for age, sex, education , and income

Odds Ratio (95% C.I.) for Association of CV Health Behaviors with Low CVD Risk in Older Age (65+ yr): NHANES 2003-2008

*All models adjusted for age, sex, education , and income

Summary

- Having a BMI < 25.0 kg/m^2 (ideal body weight) and more favorable dietary intake was associated with having all ideal CV health factors (low CVD risk)

- Associations were similar in all age groups (young, middle, older age)

Strengths and Limitations

Strengths:

•NHANES - complex, multistage probability sample of the civilian non-institutionalized U.S. population

Limitations:

•Cross-sectional – behavior changes proximal to exams possible

•Self-reported assessment of health behaviors and medical history - the possibility of inaccurate or biased data collection is evident

Public Health Implication

- BMI reflects the combined influence of dietary intake and PA on energy balance

- Increased emphasis on public health efforts aimed at reducing obesity through

  - Increases in physical activity
  - Improvements in dietary quality

- Such lifestyle changes may have the greatest impact on achieving/maintaining ideal CV health in adults of all ages

Future directions

Examine low risk/ideal CV health in other settings (electronic medical records)

- Factors related to **maintenance** of Low Risk

- Low Risk in youth/young adults

- Healthcare costs

- Access to healthcare

- Quality of healthcare

- "Low Risk" in disease populations – Diabetes

    Factors related to **maintenance** of optimal complication status

Future directions

Implement assessment of components of ideal CV health in electronic medical records

Physical activity

- Kaiser Permanente "Thrive Campaign" – added assessment of physical activity to standard medical exams

Practical dietary assessments

- Components of Healthy Diet Score: Fruits and vegetables, fish, processed meats, sugar-sweetened beverages, whole grains$\geq$3 serv/day

Acknowledgements