The National Academies of
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HEALTH AND MEDICINE DIVISION

FNB - Food Forum Workshop on Nutrition Across the Lifespan for Healthy Aging

The Role of Nutrition on Cardiovascular Health and Disease in Aging

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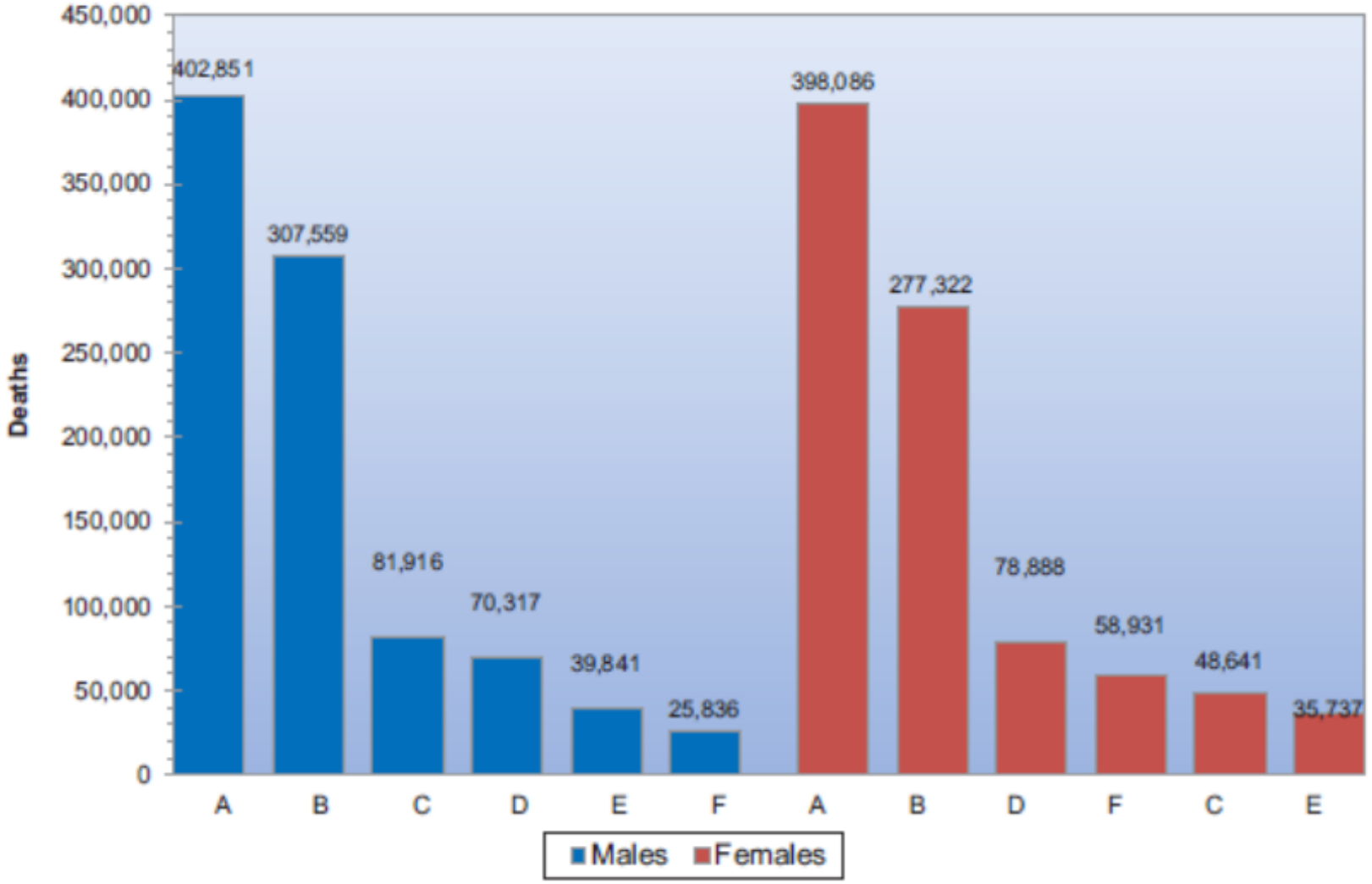
Department of Nutritional Sciences

Penn State University

Outline

- Major risk factors for CVD in children and adults - trends over time
- Relationship between CVD risk factors in children and CVD risk later in life
- Diet quality and CVD health in children and adults

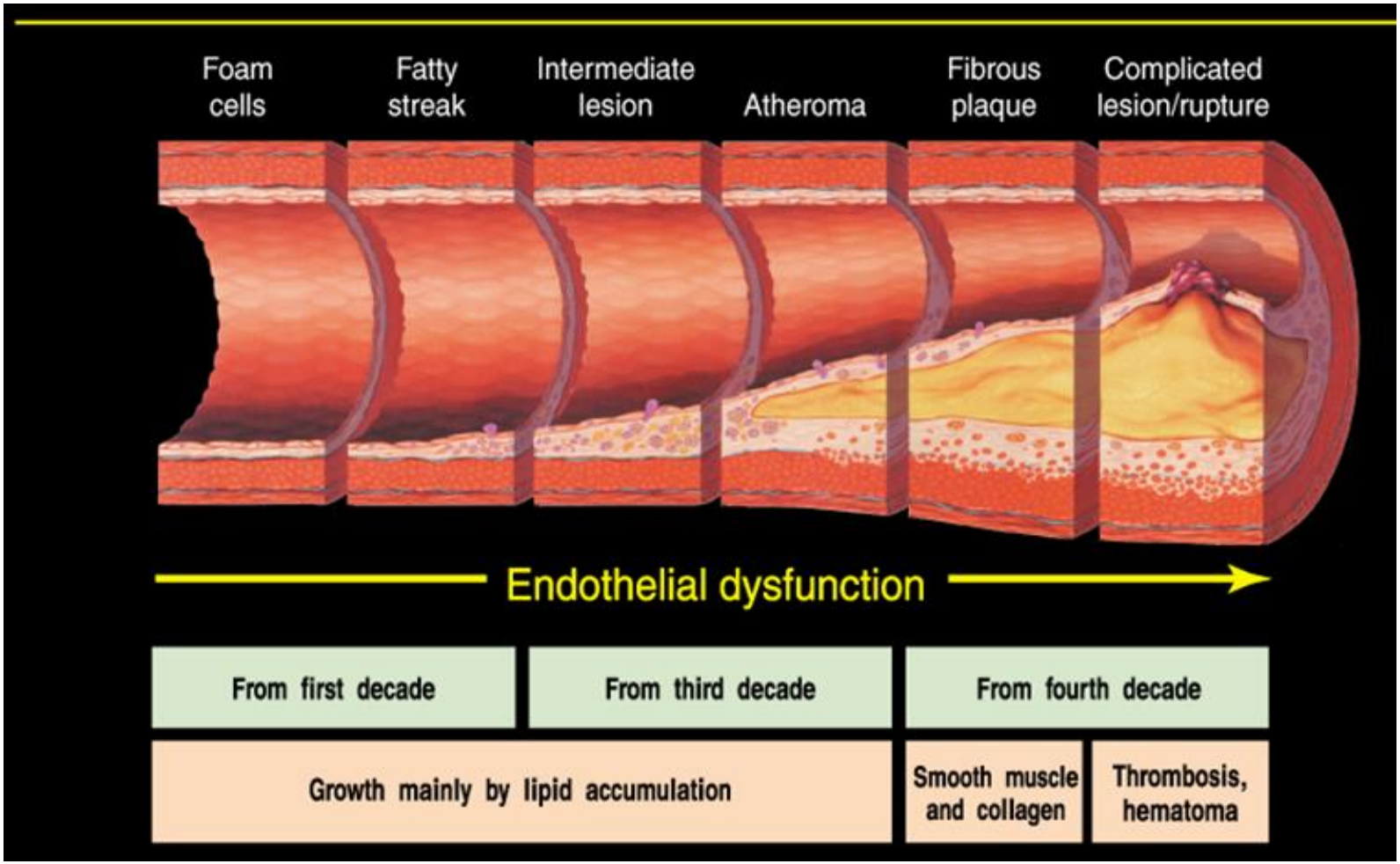
CVD and other major causes of death (United States: 2013)



Source: NCHS and NHLBI. A indicates CVD; B, cancer; C, accidents; D, CLRD; E, diabetes; and F, Alzheimer's disease.

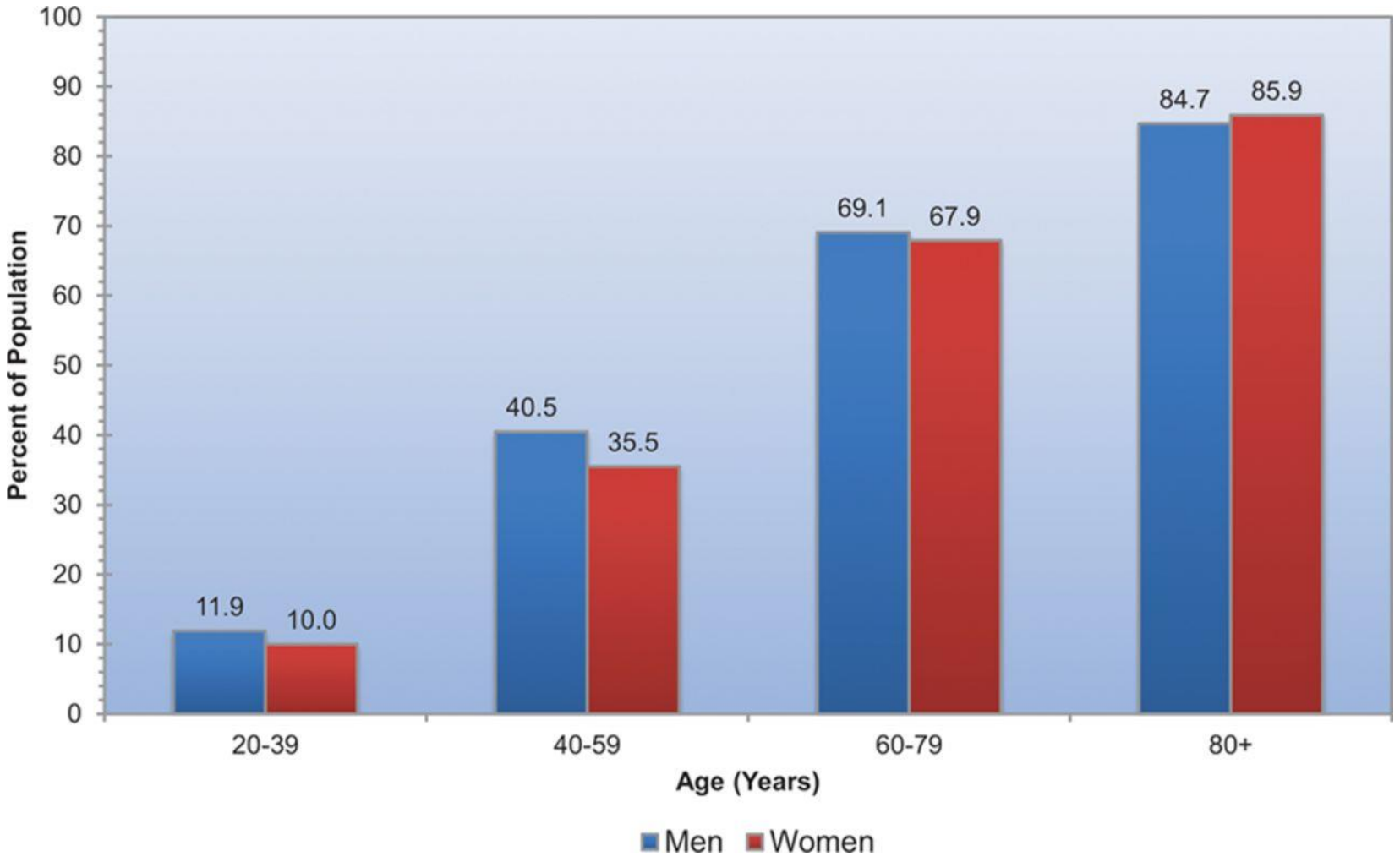
Mozaffarian D et al. Published online in *Circulation* Dec. 16, 2015

Atherosclerosis Timeline



Adapted from Pepine CJ. *Am J Cardiol*. 1998; 82(suppl.10A):23S-27S.

Prevalence of cardiovascular disease in adults ≥20 years of age by age and sex (National Health and Nutrition Examination Survey: 2009–2012).



Dariush Mozaffarian et al. Circulation. 2015;131:e29-e322

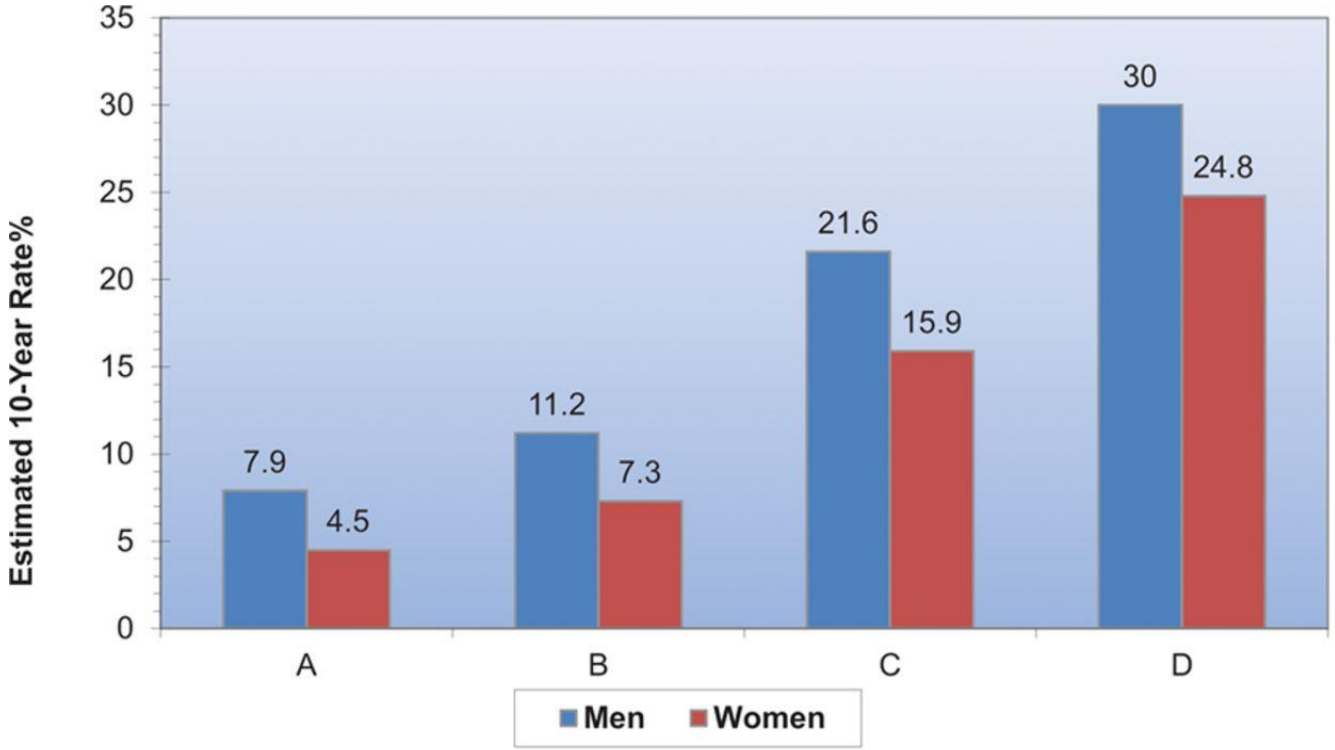
American Heart Association.

Risk Factors for CHD

- Modifiable
  - Dyslipidemia
    - High LDL-C
    - Low HDL-C
    - Elevated TG
  - Smoking
  - Hypertension
  - Diabetes mellitus
  - Obesity
  - Dietary factors
  - Thrombogenic factors
  - Sedentary lifestyle
- Nonmodifiable
  - Age
  - Sex
  - Family history of premature CHD

Wood D, et al. *Atherosclerosis*. 1998;140:199-270.

Estimated average 10-year cardiovascular disease risk in adults 50 to 54 years of age according to levels of various risk factors (Framingham Heart Study).

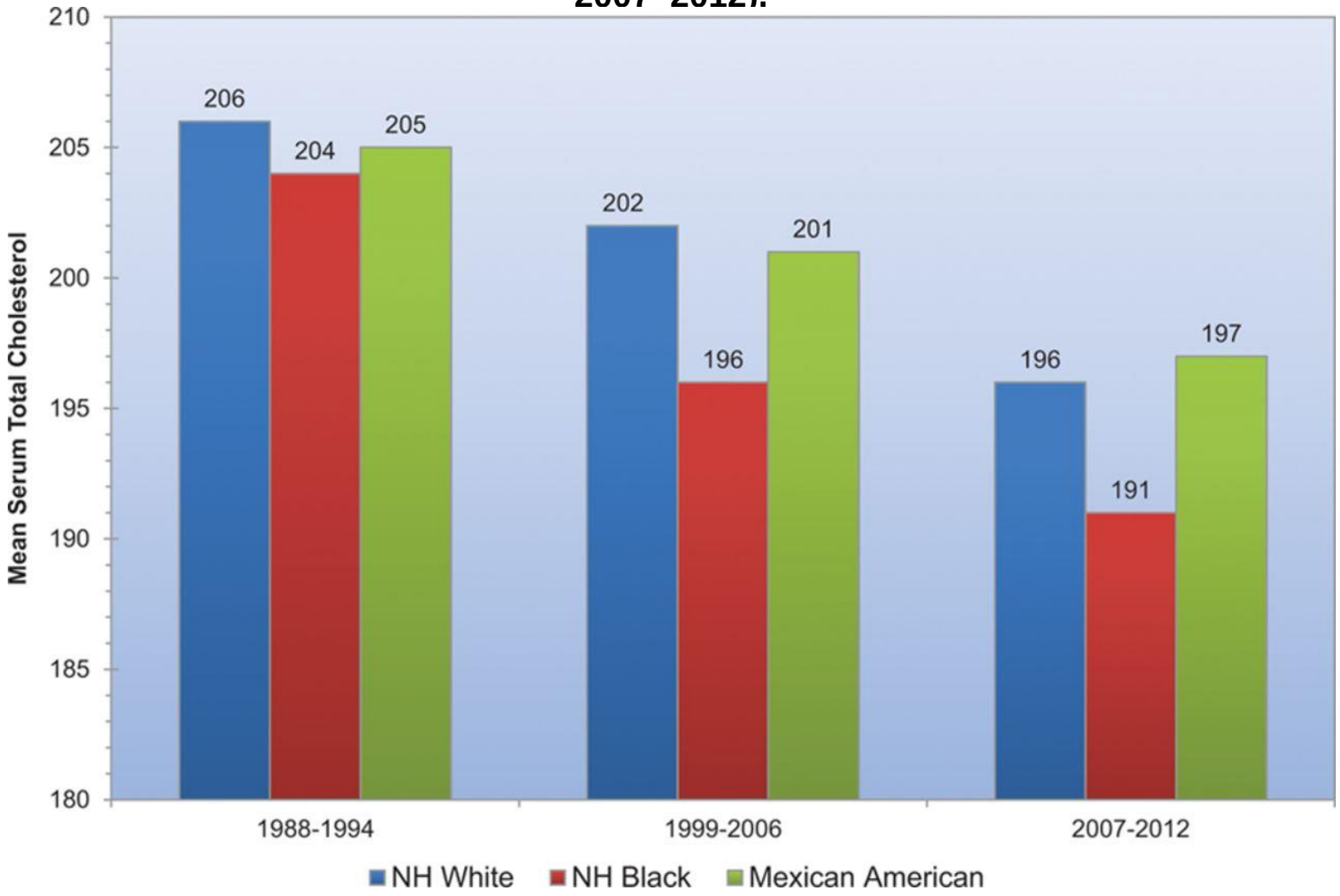


	A	B	C	D
Age	50-54	50-54	50-54	50-54
HDL Cholesterol, mg/dL	45-49	45-49	35-44	35-44
Total Cholesterol, mg/dL	160-199	200-239	200-239	200-239
Systolic BP mm/Hg, no treatment	120-129	130-139	130-139	130-139
Smoker	No	No	No	Yes
Diabetes	No	No	Yes	Yes

Dariush Mozaffarian et al. Circulation. 2015;131:e29-e322

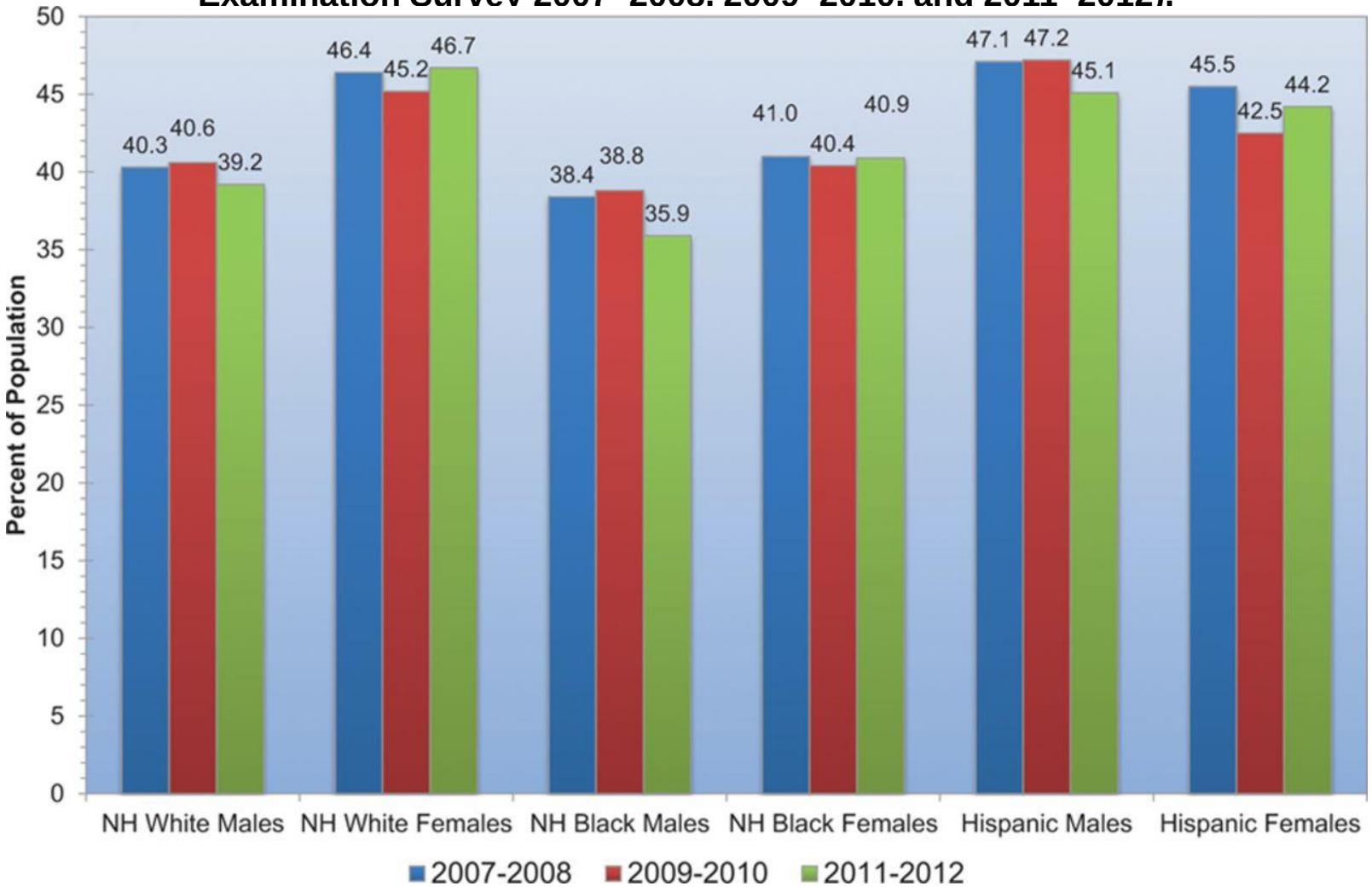
American Heart Association.

Age-adjusted trends in mean serum total cholesterol among adults ≥20 years old by race and survey year (National Health and Nutrition Examination Survey: 1988–1994, 1999–2006, and 2007–2012).



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

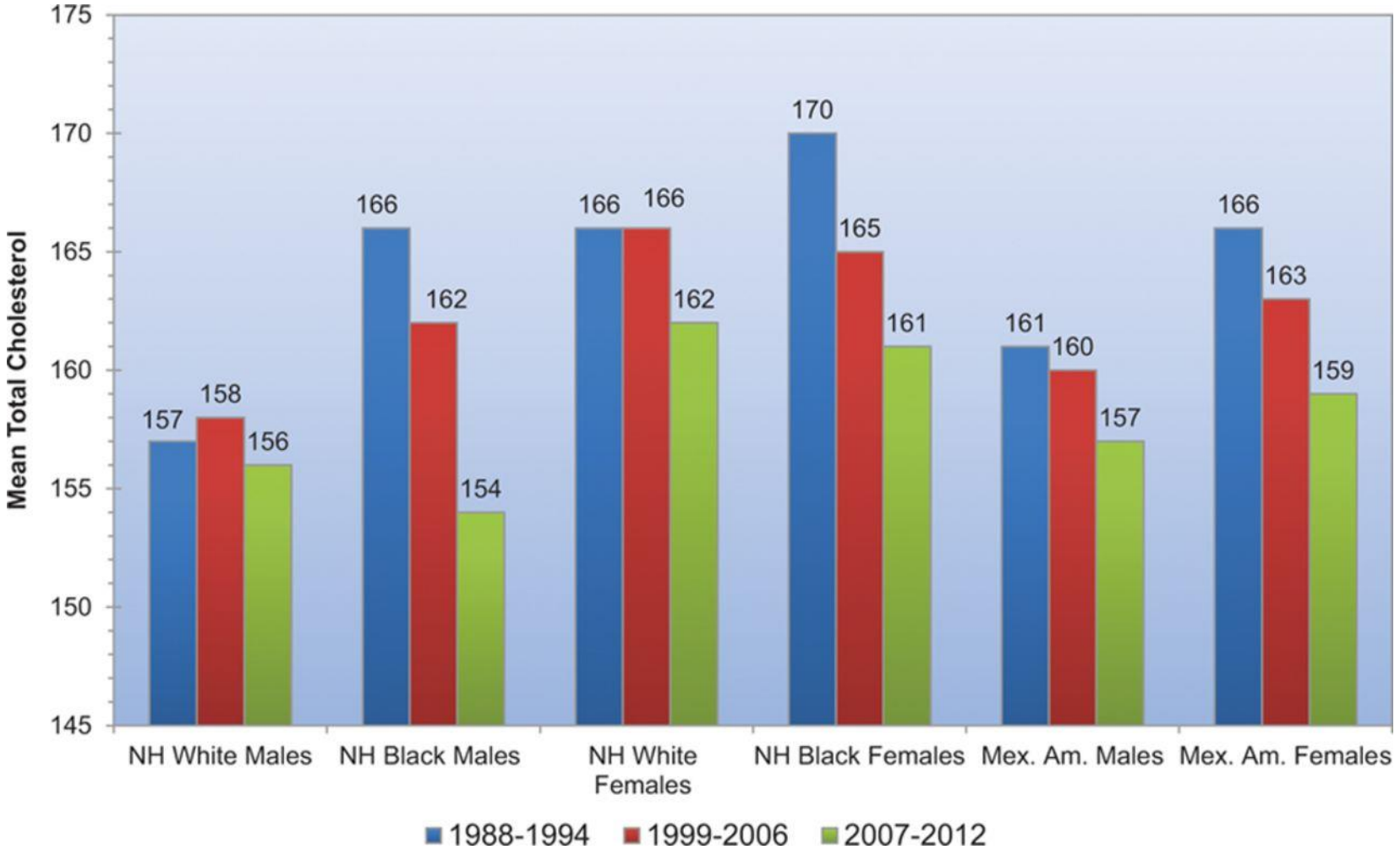
Age-adjusted trends in the prevalence of serum total cholesterol ≥200 mg/dL in adults ≥20 years of age by sex, race/ethnicity, and survey year (National Health and Nutrition Examination Survey 2007–2008. 2009–2010. and 2011–2012).



Dariush Mozaffarian et al. Circulation. 2015;131:e29-e322

American Heart Association.

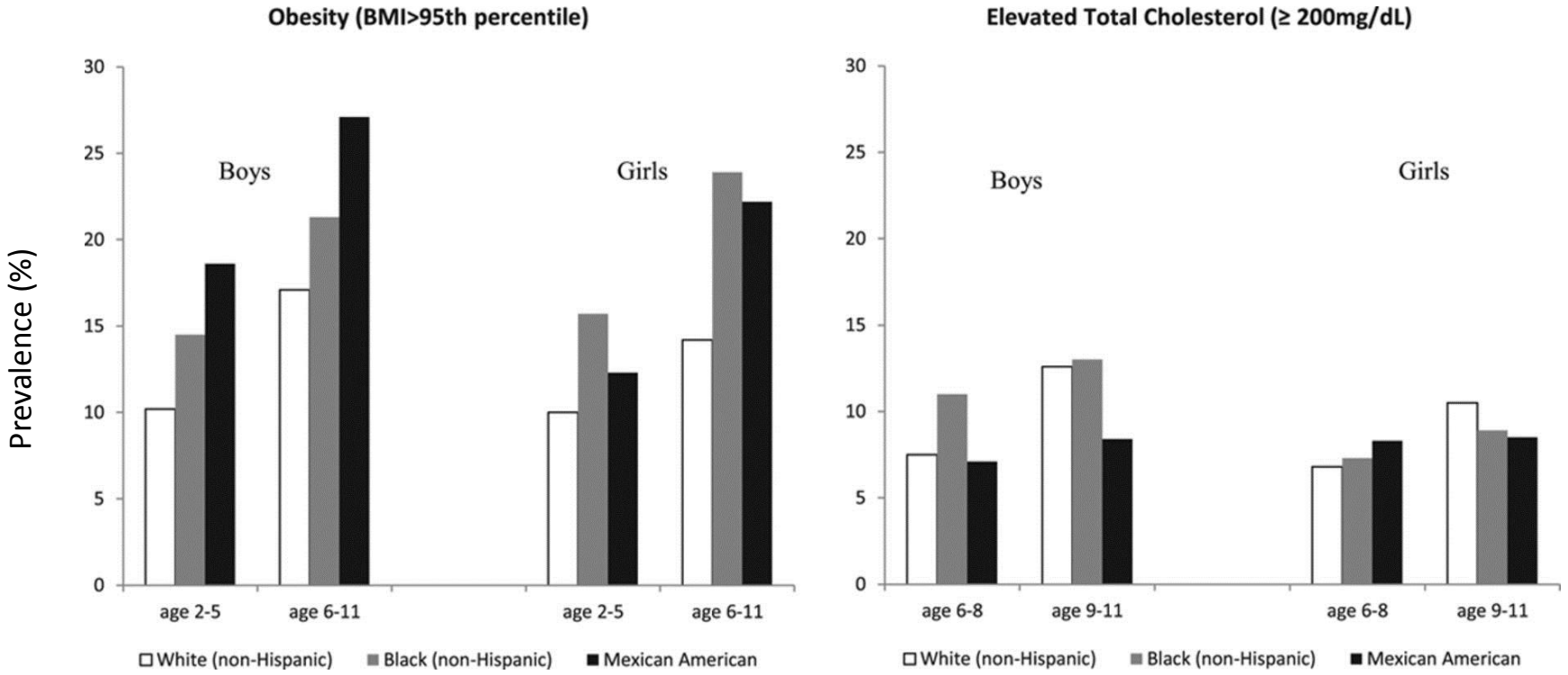
Trends in mean serum total cholesterol among adolescents 12 to 19 years of age by race, sex, and survey year (National Health and Nutrition Examination Survey: 1988–1994, 1999–2006, and 2007–2012).



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

American Heart Association.

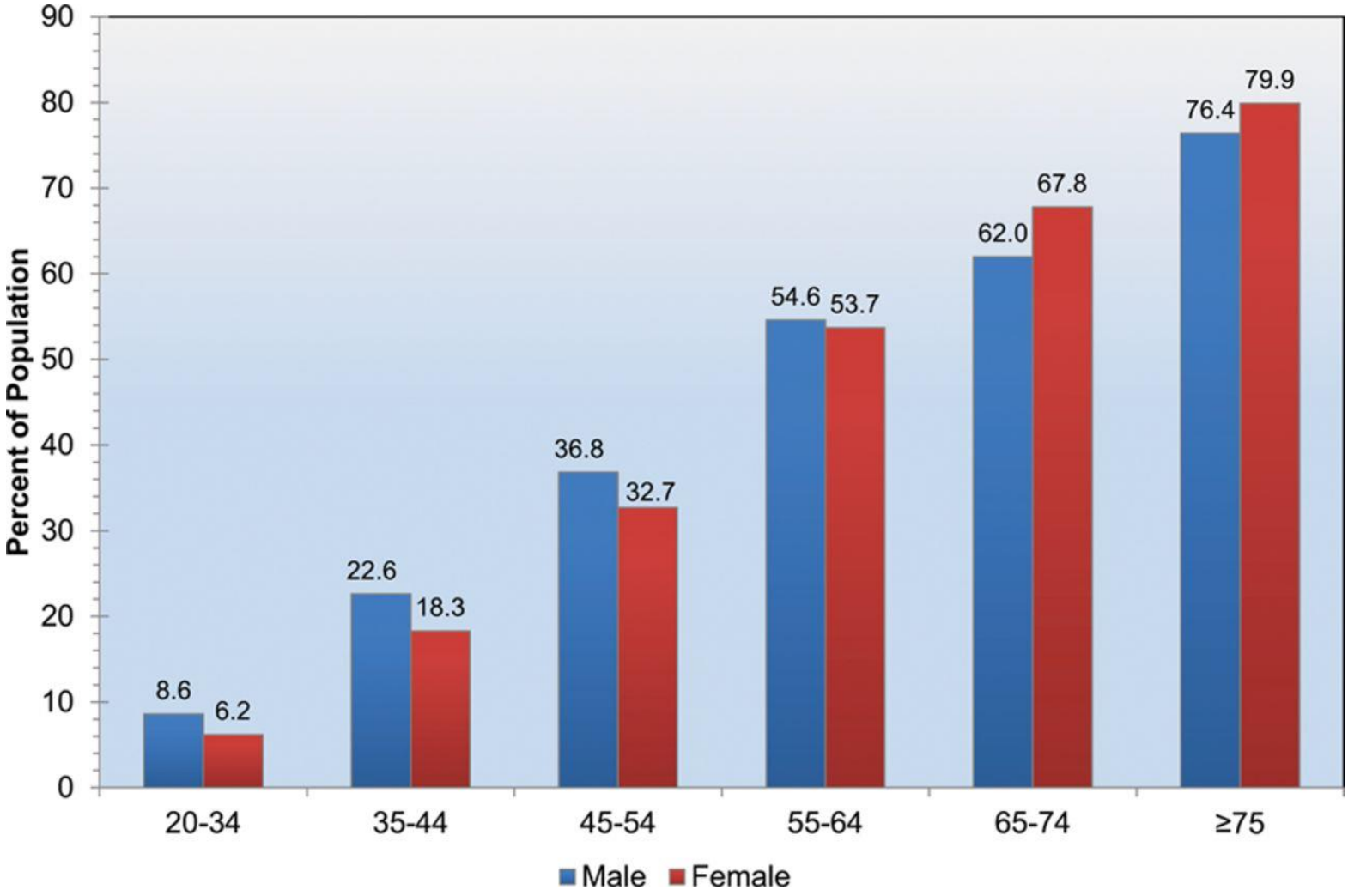
Prevalence of obesity and elevated cholesterol in children by age and race/ethnicity: NHANES 2003 to 2010.



American Heart Association.

Hongyan Ning et al. Circ Cardiovasc Qual Outcomes. 2015;8:164-171

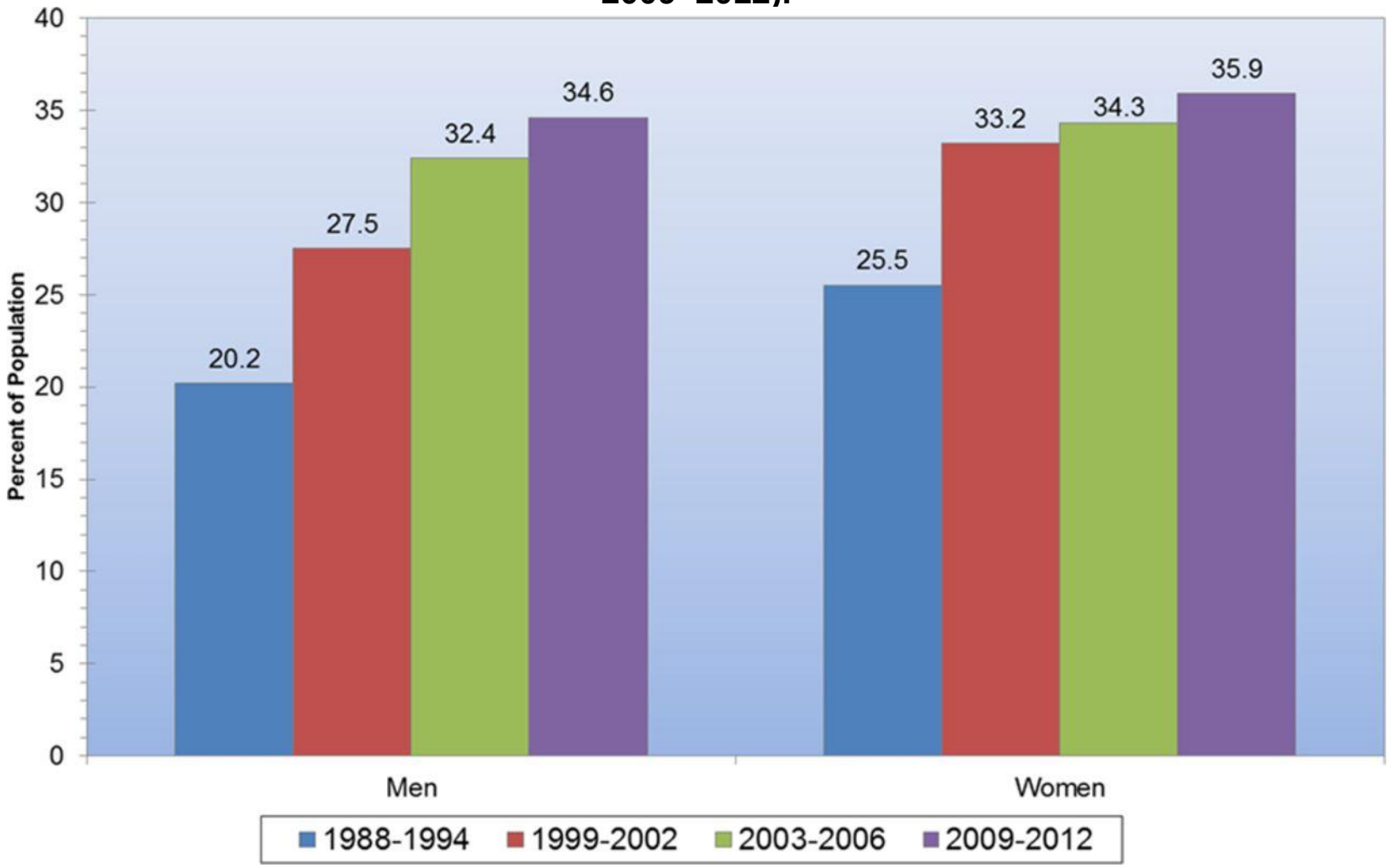
Prevalence of high blood pressure in adults ≥20 years of age by age and sex (National Health and Nutrition Examination Survey: 2007–2012).



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

American Heart Association.

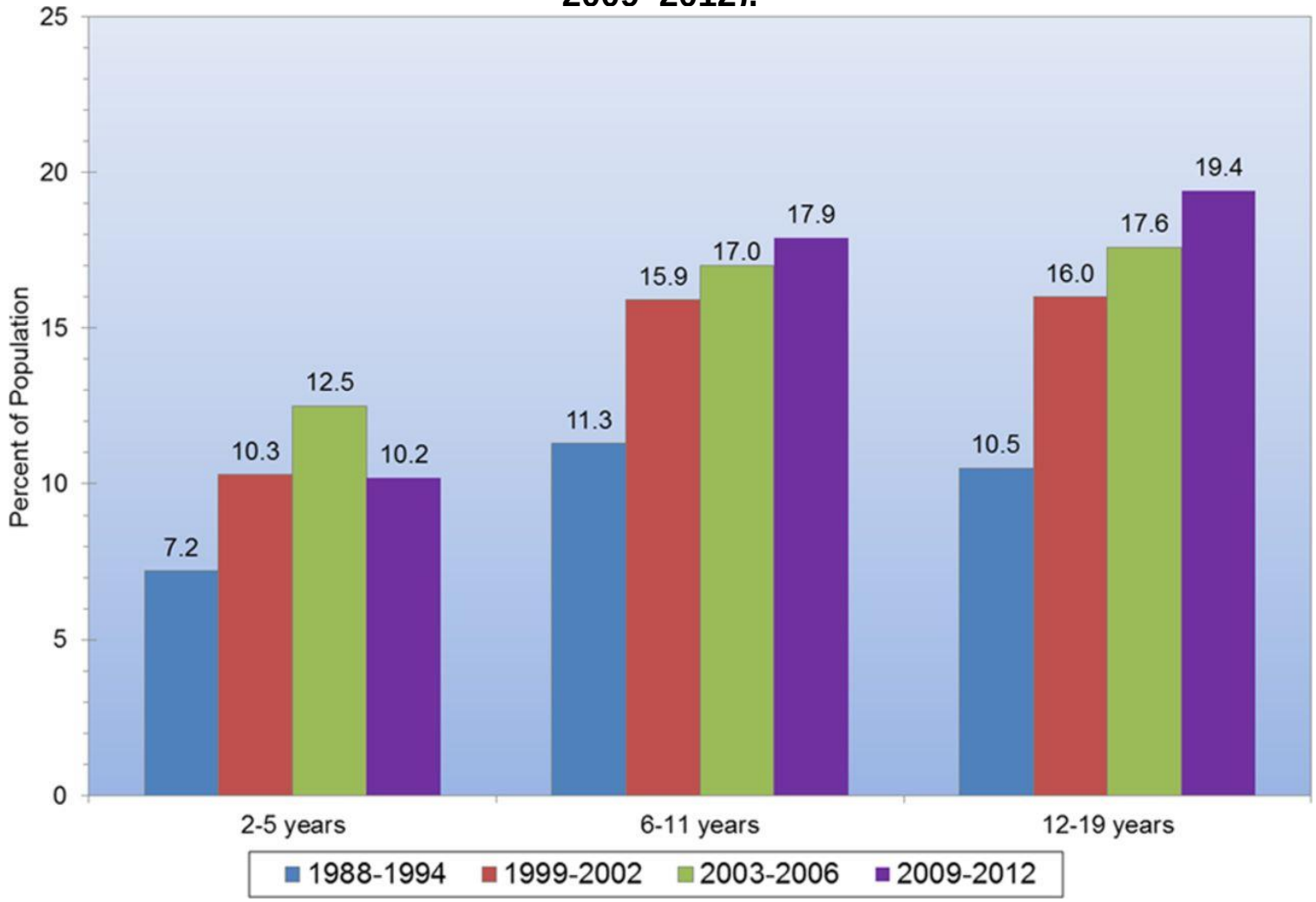
Age-adjusted prevalence of obesity in adults 20 to 74 years of age by sex and survey year (National Health and Nutrition Examination Survey: 1988–1994, 1999–2002, 2003–2006, and 2009–2012).



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

American Heart Association.

Trends in the prevalence of obesity among US children and adolescents by age and survey year (National Health and Nutrition Examination Survey: 1988–1994, 1999–2002, 2003–2006, 2009–2012).



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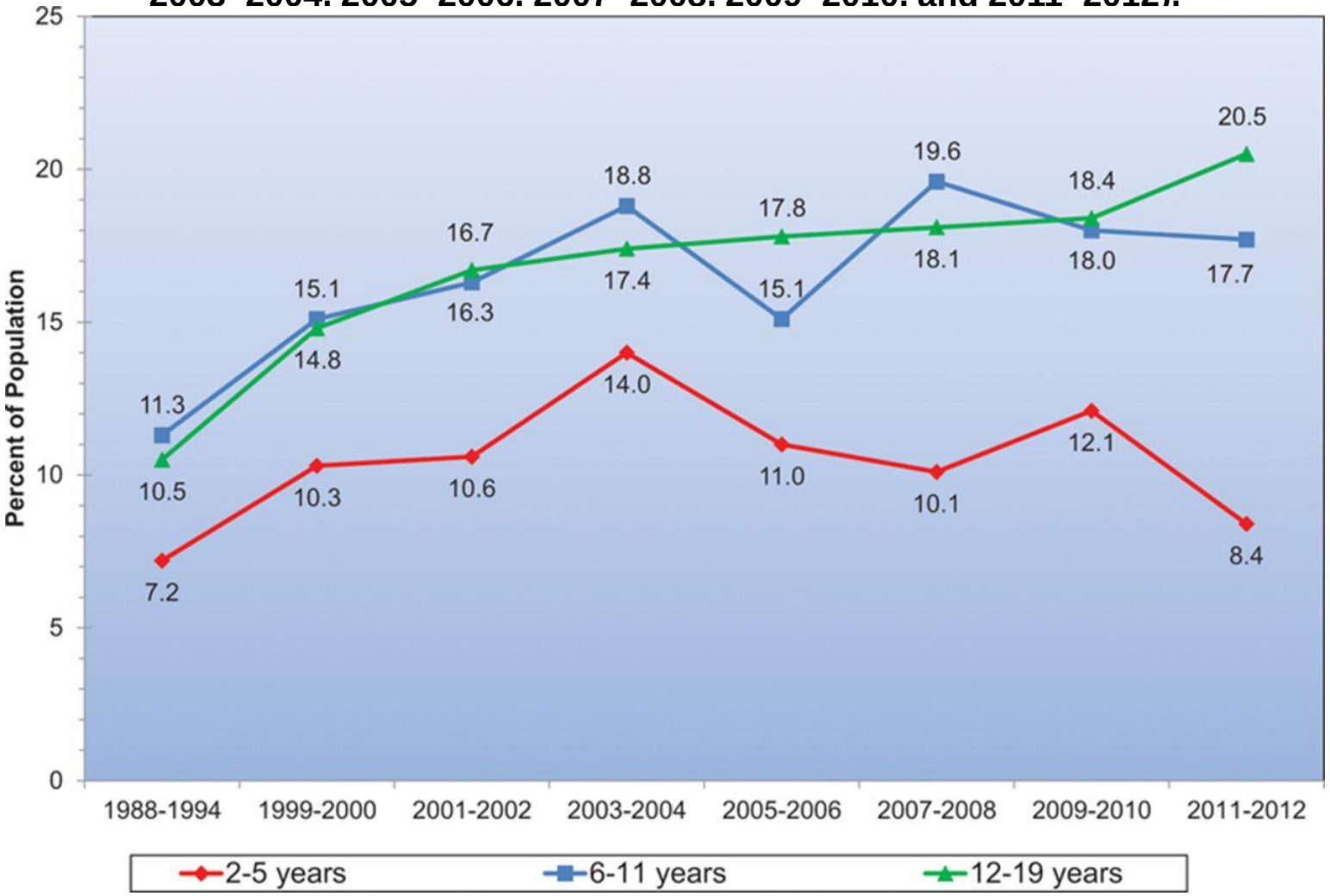
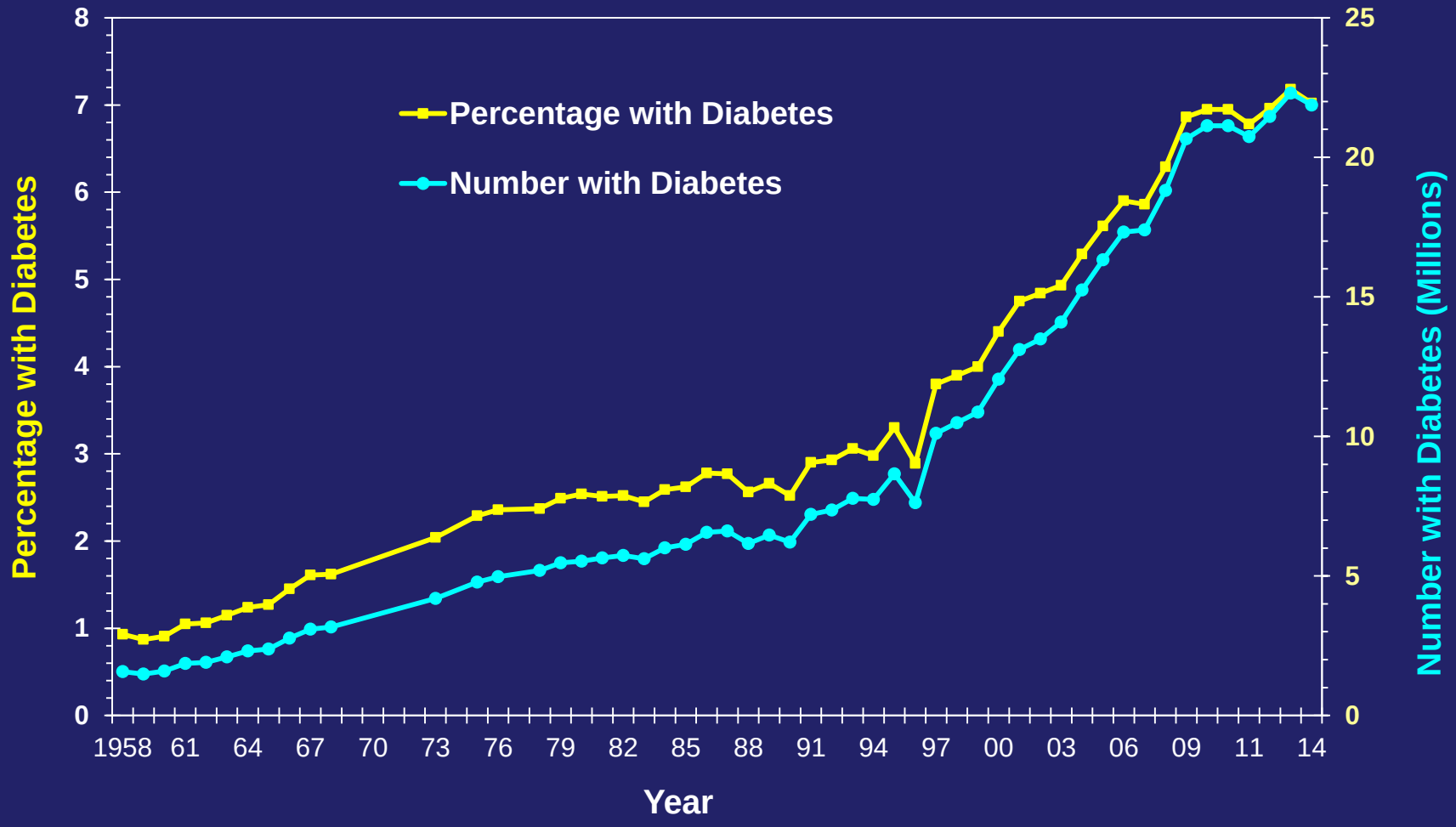


Dariush Mozaffarian et al. Circulation. 2015;131:e29-e322

American Heart Association.

Number and Percentage of U.S. Population with Diagnosed Diabetes, 1958-2014



CDC's Division of Diabetes Translation. United States Diabetes Surveillance System available at http://www.cdc.gov/diabetes/data

Prevalence of Type 2 Diabetes Among Children and Adolescents From 2001 to 2009

	2001 Population			2009 Population				
	No. of Youth			No. of Youth				
	Cases with Diabetes	General population	Prevalence per 1000 (95% CI)	Cases with Diabetes	General population	Prevalence per 1000 (95% CI)	Difference in Prevalence (95% CI)	P Value
Total	**588**	**1,725,856**	**0.34 (0.31 to 0.37)**	**819**	**1,781,260**	**0.46 (0.43 to 0.49)**	**0.12 (0.10 to 0.14)**	**<0.001**

Dabelea et al. JAMA. 2014;311(17):1778-1786.

Prevalence of Diagnosed Diabetes in Children by Race/Ethnicity SEARCH for Diabetes in Youth (SEARCH) Study

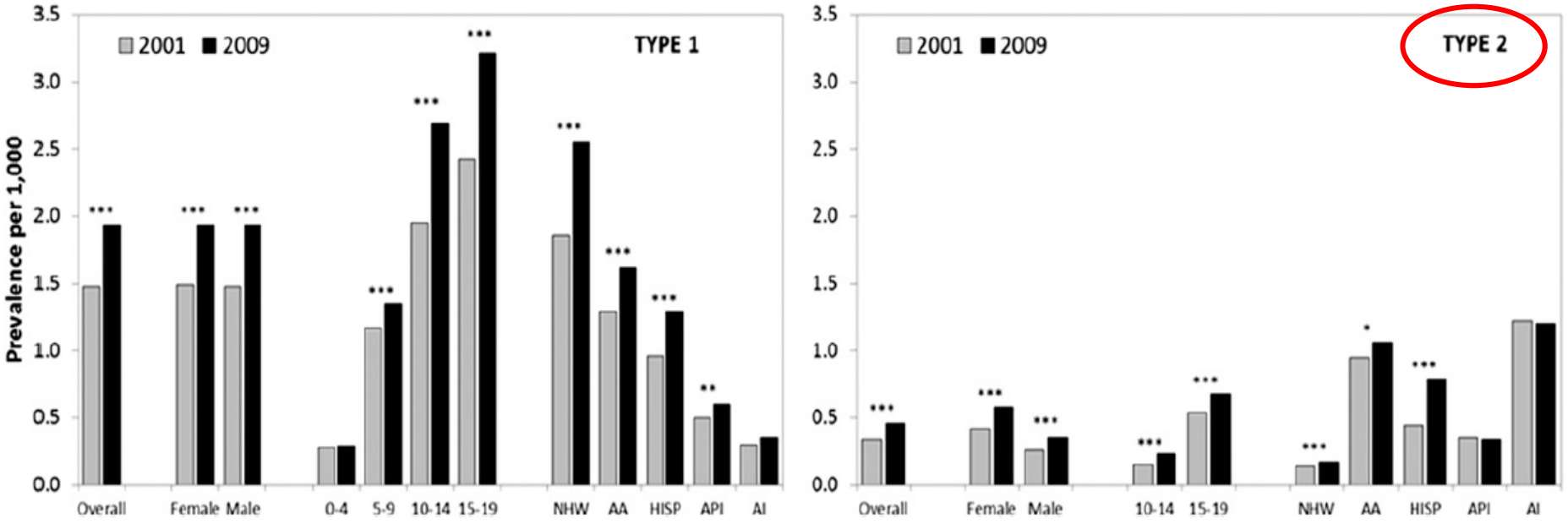


Figure 2—Prevalence (per 1,000) of diabetes by type, sex, age group, and race/ethnic group in 2001 and 2009 (2). *P* values for change between years: $*P < 0.05$; $**P < 0.01$; $***P < 0.001$. AA, African American; AI, American Indian; API, Asian Pacific Islander; HISP, Hispanic; NHW, non-Hispanic white.

Hamman et al., Diabetes Care. 2014;37:3336-3344.

Relation of childhood BMI to adult obesity

N	Childhood		Adulthood			
	BMI %tile	Age	BMI	BMI ≥30	BMI ≥35	BMI ≥40
1161	0- 49	13 ± 2	22.7 ± 4	5%	1%	0
832	50- 84	12 ± 2	27.1 ± 5	23%	8%	2%
130	85- 89	13 ± 2	30.3 ± 5	47%	16%	5%
121	90- 94	12 ± 2	32.4 ± 6	64%	33%	13%
122	95- 98	13 ± 2	37.1 ± 7	84%	60%	34%
26	≥99	12 ± 3	43.6 ± 9	100%	88%	65%

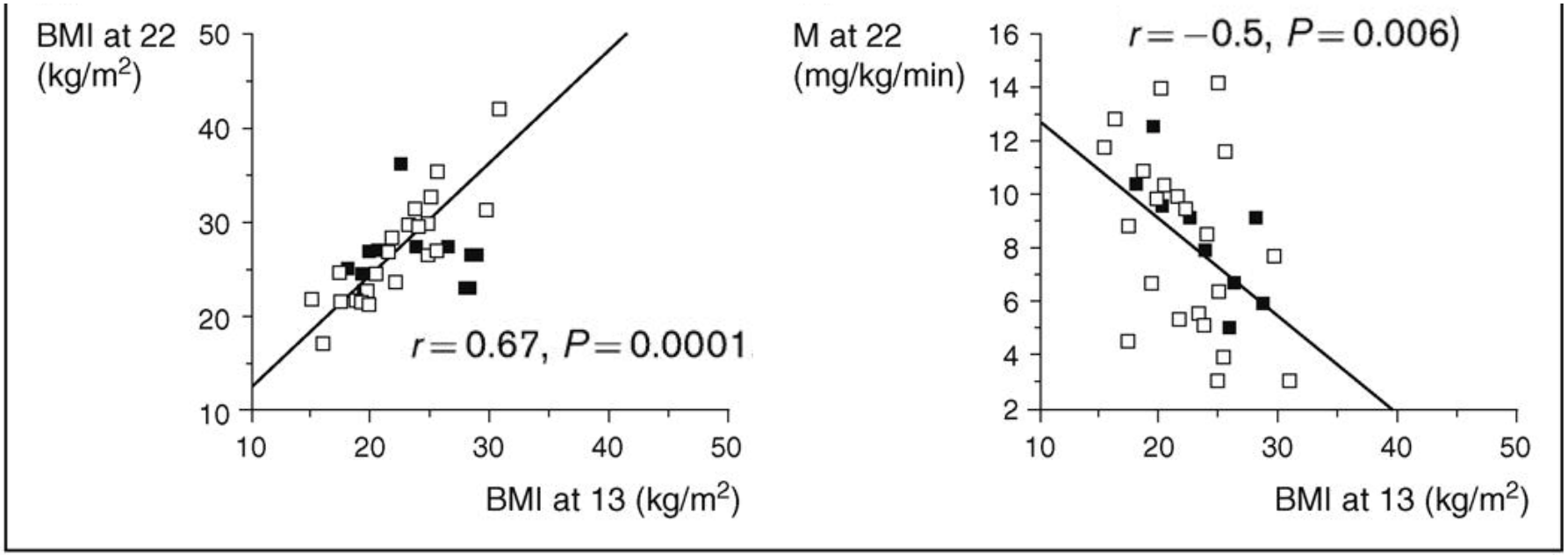
Findings from The Bogalusa Heart Study:

- Whereas only 5% of the 1161 children with a BMI <50 percentile became obese adults, 84% of the children with a BMI between the 95th and 98th percentiles, and all of the children with a BMI ≥99th percentile, were obese in adulthood.
- In addition, 88% of children with a BMI ≥99th percentile had an adult BMI ≥35 kg/m^2.

Freedman DS et al. J Pediatr. 2007;150(1):12-17.e2.

Relation of BMI at age 13 to BMI at age 22, and to insulin resistance at age 22

- Obese children are far more likely to be obese young adults, and cardiovascular risk factors commonly encountered in this population (e.g. abnormal lipid profiles and increased blood pressure) track from childhood into adulthood



□ Female; ■ Male.

M=insulin sensitivity

Nathan and Moran. Curr Opin Endocrinol Diabetes Obes. 2008;15(1):21-29.

Relative Risks of High-Risk Outcomes in Adulthood among Participants in Four Cohort Studies Who Were Overweight or Obese in Childhood.

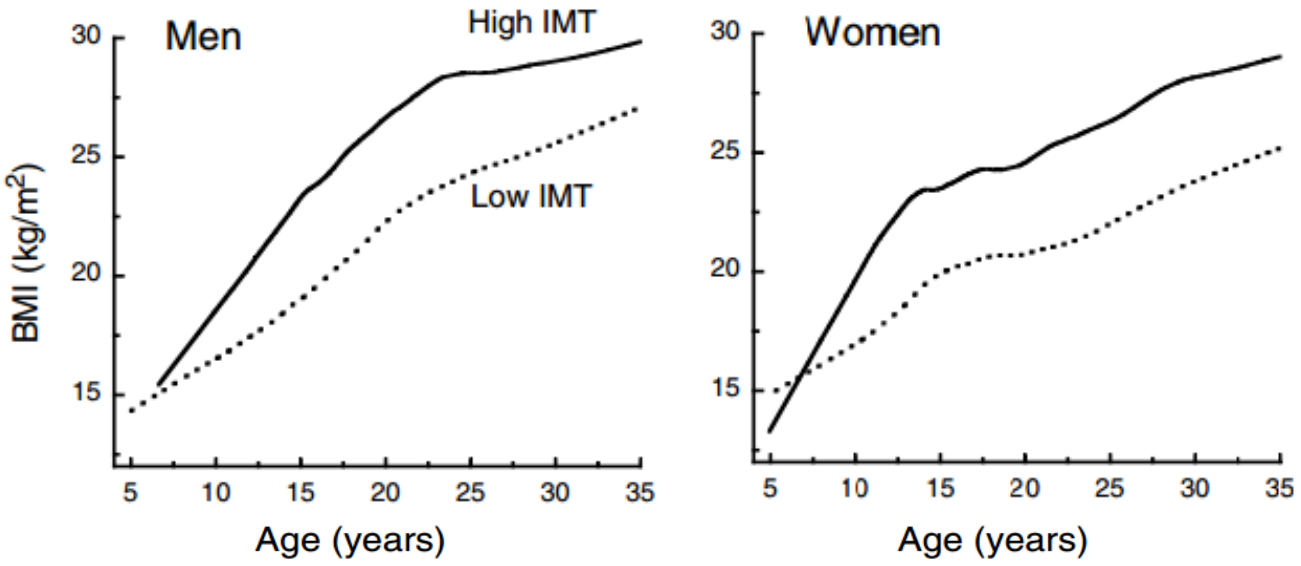
Outcome	Bogalusa	Muscatine	CDAH	YFS	Male Subjects†	Female Subjects†	All Subjects†
Type 2 diabetes							
Relative risk (95% CI)	2.2 (1.3–3.8)	3.4 (1.6–7.1)	0.5 (0.1–3.5)	2.6 (1.2–5.8)	3.8 (2.1–6.9)	1.8 (1.1–3.0)	2.4 (1.6–3.6)
P value	0.006	0.002	0.46	0.02	<0.001	0.02	<0.001
Hypertension							
Relative risk (95% CI)	2.0 (1.3–2.8)	2.3 (1.4–3.9)	1.5 (1.0–2.2)	1.8 (1.4–2.3)	1.8 (1.5–2.2)	1.7 (1.3–2.4)	1.8 (1.5–2.1)
P value	<0.001	0.001	0.03	<0.001	<0.001	<0.001	<0.001
High-risk LDL cholesterol							
Relative risk (95% CI)	1.8 (1.3–2.6)	1.3 (0.7–2.4)	1.6 (1.1–2.3)	1.2 (0.8–1.7)	1.2 (0.9–1.6)	2.0 (1.4–2.7)	1.4 (1.2–1.8)
P value	0.001	0.39	0.02	0.31	0.18	<0.001	<0.001
High-risk HDL cholesterol							
Relative risk (95% CI)	1.5 (1.2–1.9)	1.3 (1.1–1.6)	1.4 (1.0–1.9)	1.6 (1.2–2.0)	1.2 (1.0–1.5)	1.8 (1.4–2.3)	1.4 (1.2–1.6)
P value	0.001	0.004	0.06	0.001	0.03	<0.001	<0.001
High-risk triglycerides							
Relative risk (95% CI)	1.8 (1.2–2.7)	1.8 (1.2–2.5)	1.8 (1.2–2.6)	1.5 (1.1–2.0)	1.6 (1.3–2.1)	1.6 (1.1–2.3)	1.6 (1.3–1.9)
P value	0.009	0.002	0.007	0.01	<0.001	0.02	<0.001
High-risk carotid-artery intima–media thickness‡							
Relative risk (95% CI)	2.5 (1.5–4.1)	1.4 (0.9–2.2)	1.0 (0.7–1.3)	1.5 (1.1–2.1)	1.3 (1.0–1.7)	1.3 (1.0–1.7)	1.3 (1.1–1.6)
P value	0.001	0.14	0.98	0.007	0.05	0.06	0.007

Juonala et al. N Engl J Med. 2011;365(20):1876-1885.

The relation of obesity throughout life to carotid intima-media thickness (IMT) in adulthood: Bogalusa Heart Study

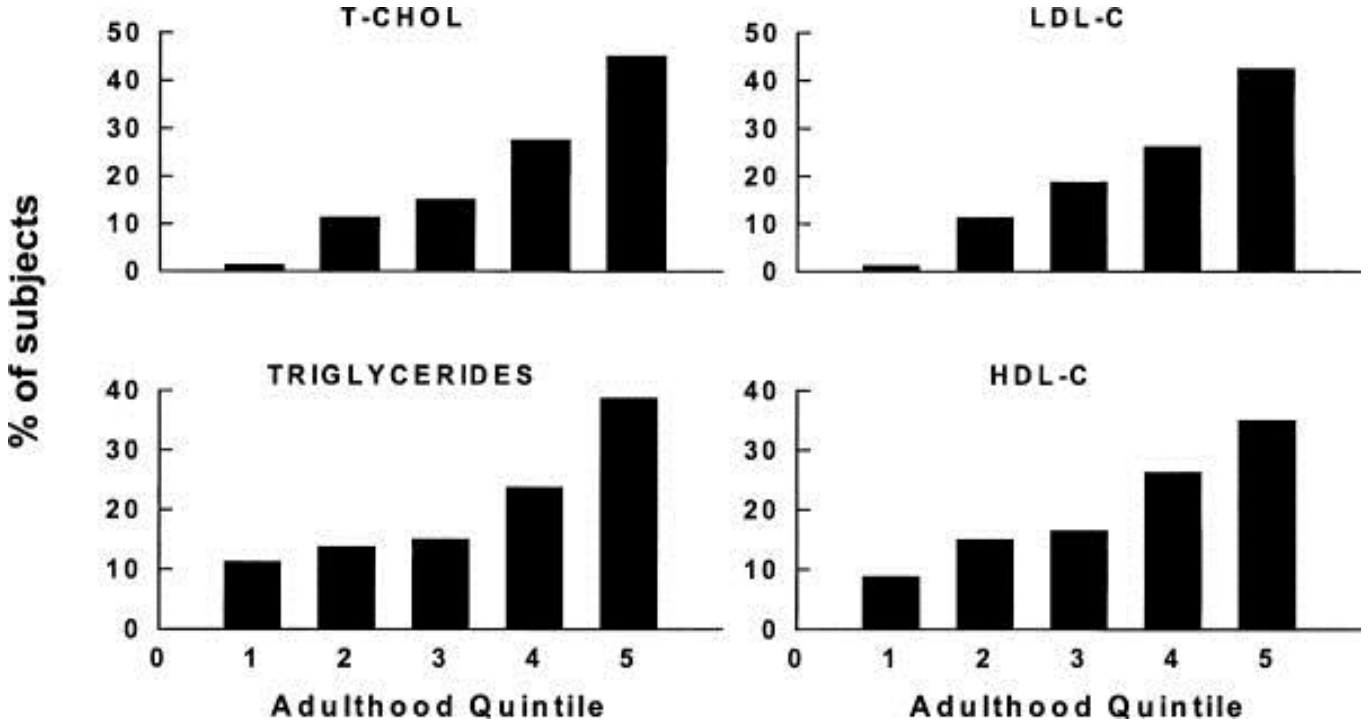
- By age 10 y, BMI levels were 2–3 kg/m^2 higher among both boys and girls who subsequently had high levels of carotid IMT in adulthood than among those who had low adult levels of IMT.
- These BMI differences tended to increase with age, reaching ~5 kg/m^2 among men between the ages of 20 and 25 y, and ~4 kg/m^2 among women by age 15 y.

BMI by age for persons with high (>90th %ile) or low (<10th %ile) levels of carotid IMT in adulthood



Freedman et al. Int J Obes Relat Metab Disord. 2004;28(1):159-166.

Distribution of subjects with elevated childhood lipoprotein elevation after 15 years in the Bogalusa Heart Study.



- Of those individuals who had elevated (> 80th percentile) levels of serum total cholesterol, more than 40 % continued to have elevated levels 15 years later. Persistence of HDL-C levels was noted over the 15-year period along with triglycerides, but to a lesser degree

Nicklas et al. Int J Sports Med. 2002 May;23 Suppl 1:S39-43.

From: **Cardiovascular Risk Factors in Childhood and Carotid Artery Intima-Media Thickness in Adulthood: The Cardiovascular Risk in Young Finns Study**

JAMA. 2003;290(17):2277-2283. doi:10.1001/jama.290.17.2277

Table 4. Multivariable Model of the Relationships Between Risk Variables Measured at Ages 12-18 Years and Common Carotid Artery Intima-Media Thickness Measured 21 Years Later (n = 1170)*

Risk Variable	Regression Coefficient†	SE	*P* Value
Male sex	0.023	0.006	<.001
Age	0.002	0.001	.24
LDL-C	0.010	0.003	.001
Body mass index	0.009	0.003	.007
Systolic blood pressure	0.013	0.003	<.001
Smoking (no/yes)	0.016	0.007	.02

Abbreviation: LDL-C, low-density lipoprotein cholesterol.
*Mean age at time of first measurement, 14.9 (SD, 2.4) years.
†Expressed in millimeters for a 1-unit change in age (year) and a 1-SD change in other continuous variables and for the presence or absence of smoking.

From: **Cardiovascular Risk Factors in Childhood and Carotid Artery Intima-Media Thickness in Adulthood: The Cardiovascular Risk in Young Finns Study**

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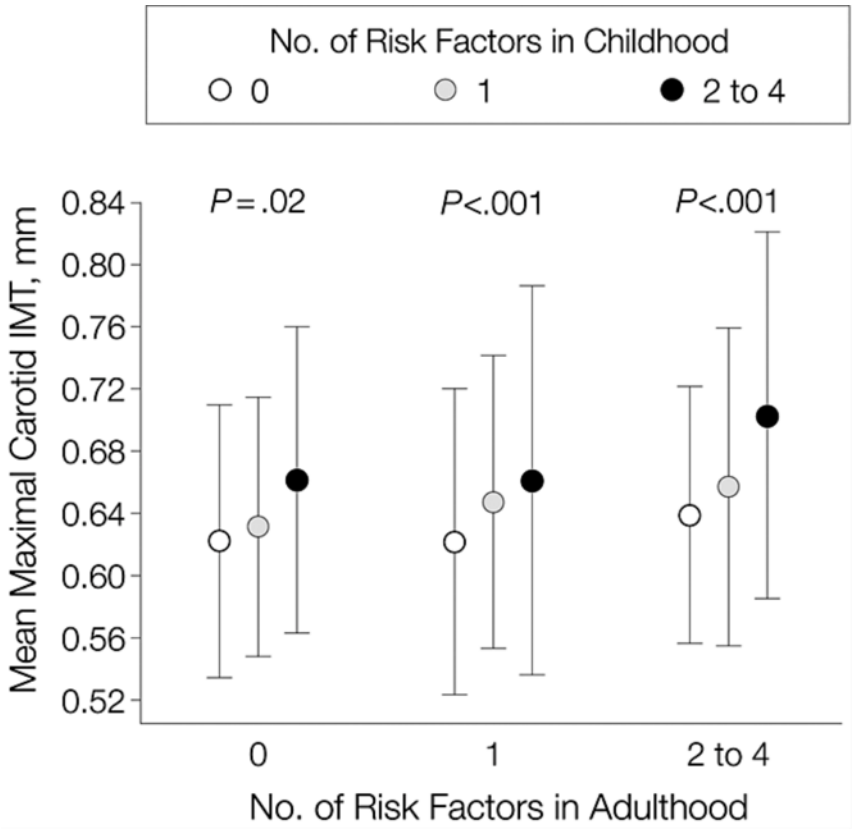
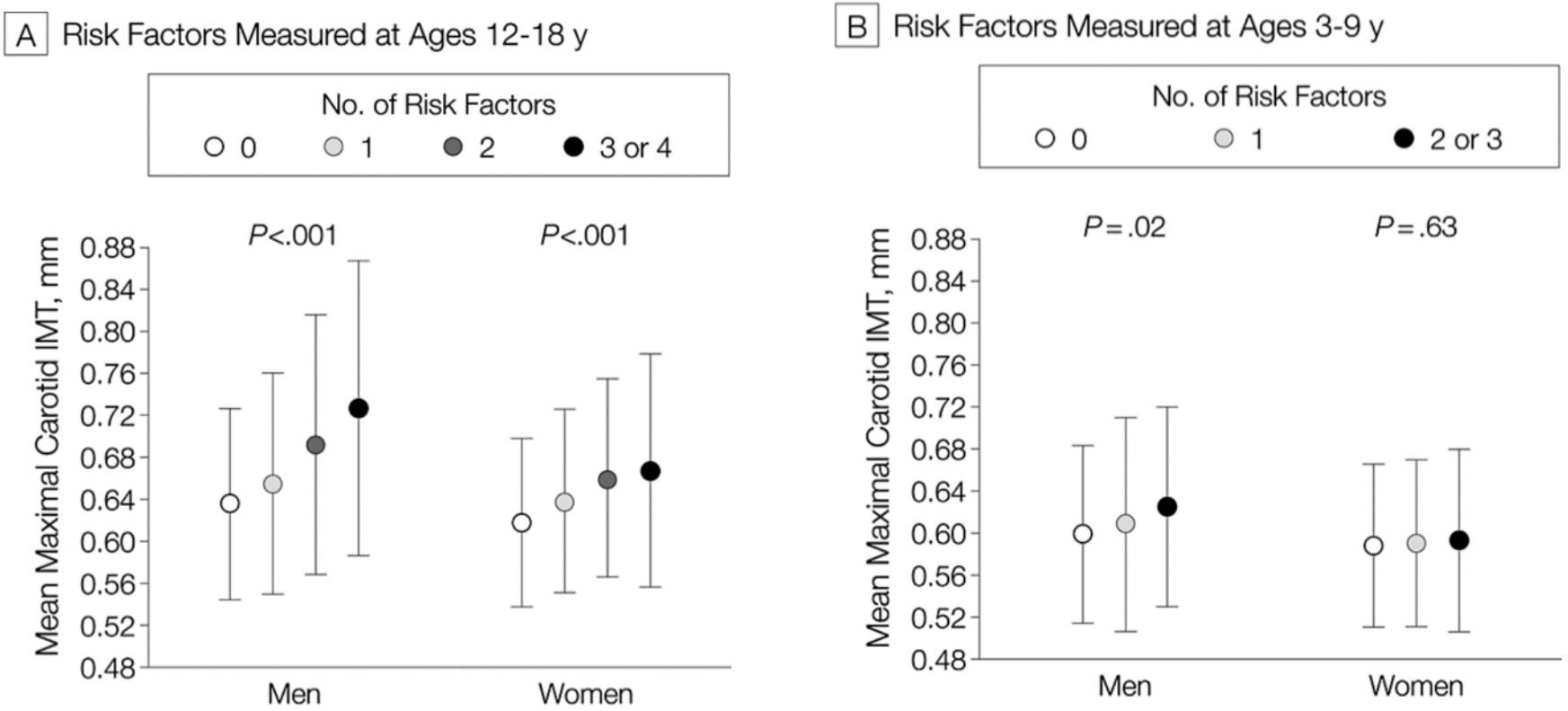


Risk factors include cigarette smoking as well as levels in the 80th percentile of LDL-cholesterol, SBP, and BMI. The numbers of current and childhood risk factors were significantly related to common carotid artery IMT (P<.001for both). Error bars indicate SDs.

From: **Cardiovascular Risk Factors in Childhood and Carotid Artery Intima-Media Thickness in Adulthood: The Cardiovascular Risk in Young Finns Study**

JAMA. 2003;290(17):2277-2283. doi:10.1001/jama.290.17.2277



Risk factors were measured at ages 12 to 18 years (A) and 3 to 9 years (B) and common carotid artery IMT was measured 21 years later in adulthood. P values are from regression analysis testing for increasing linear trend in IMT values across the categories. Risk factors include cigarette smoking as well as levels in the 80th percentile of LDL-cholesterol, SBP, and BMI. Error bars indicate SDs.

From: **Childhood Cardiovascular Risk Factors and Carotid Vascular Changes in Adulthood: The Bogalusa Heart Study**

JAMA. 2003;290(17):2271-2276. doi:10.1001/jama.290.17.2271

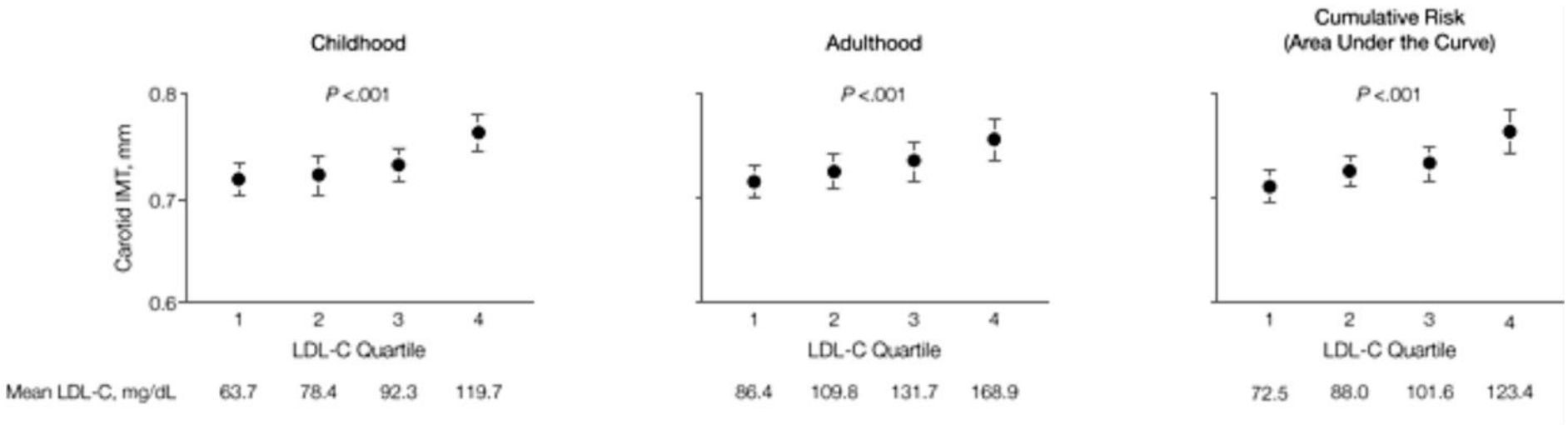


Figure Legend:

Data are mean (95% confidence interval). IMT indicates intima-media thickness; LDL-C, low-density lipoprotein cholesterol. P values for differences among quartiles were adjusted for age, race,and sex. z Scores specific for age, race, and sex were used to define quartiles of LDL-C level. To convert LDL-C to mmol/L, multiply values by 0.0259.

From: **Childhood Cardiovascular Risk Factors and Carotid Vascular Changes in Adulthood: The Bogalusa Heart Study**

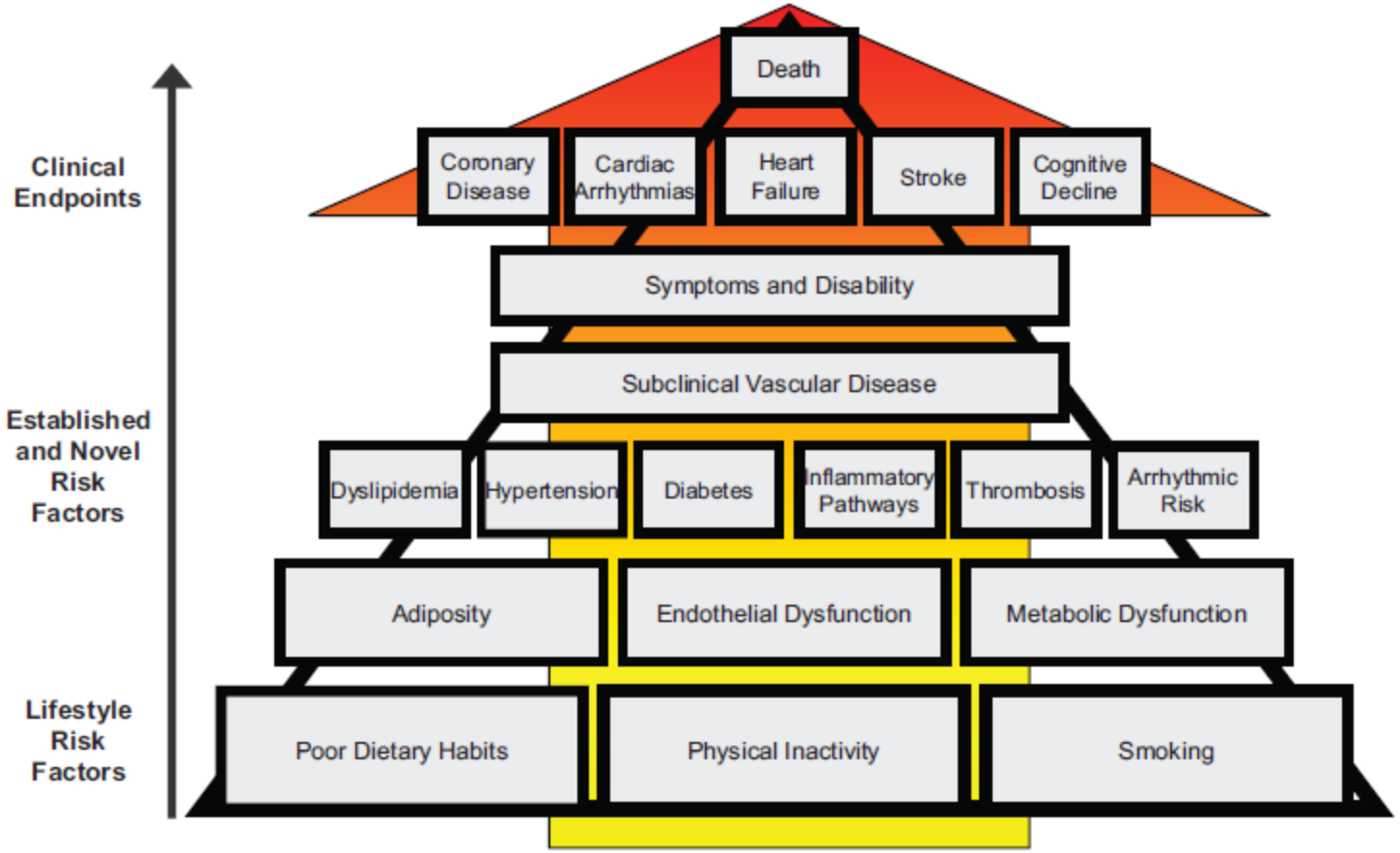
JAMA. 2003;290(17):2271-2276. doi:10.1001/jama.290.17.2271

Table 2. Pearson Correlation Coefficients of Carotid IMT in Young Adults With Risk Factors Measured Since Childhood*

	Body Mass Index		Systolic Blood Pressure		HDL-C		LDL-C		Triglycerides	
	Correlation Coefficient	*P* Value	Correlation Coefficient	*P* Value	Correlation Coefficient	*P* Value	Correlation Coefficient	*P* Value	Correlation Coefficient	*P* Value
Childhood (4-17 y)	0.162	<.001	0.103	.02	−0.041	.37	0.177	<.001	0.048	.29
Adulthood (25-37 y)	0.165	<.001	0.216	<.001	−0.201	<.001	0.191	<.001	0.109	.02
Cumulative risk (AUC)	0.180	<.001	0.165	<.001	−0.152	<.001	0.227	<.001	0.134	.003

Abbreviations: AUC, area under the curve divided by follow-up years; HDL-C, high-density lipoprotein cholesterol; IMT, intima-media thickness; LDL-C, low-density lipoprotein cholesterol.
*z Scores specific for age, race, and sex were used for carotid IMT and risk factors.

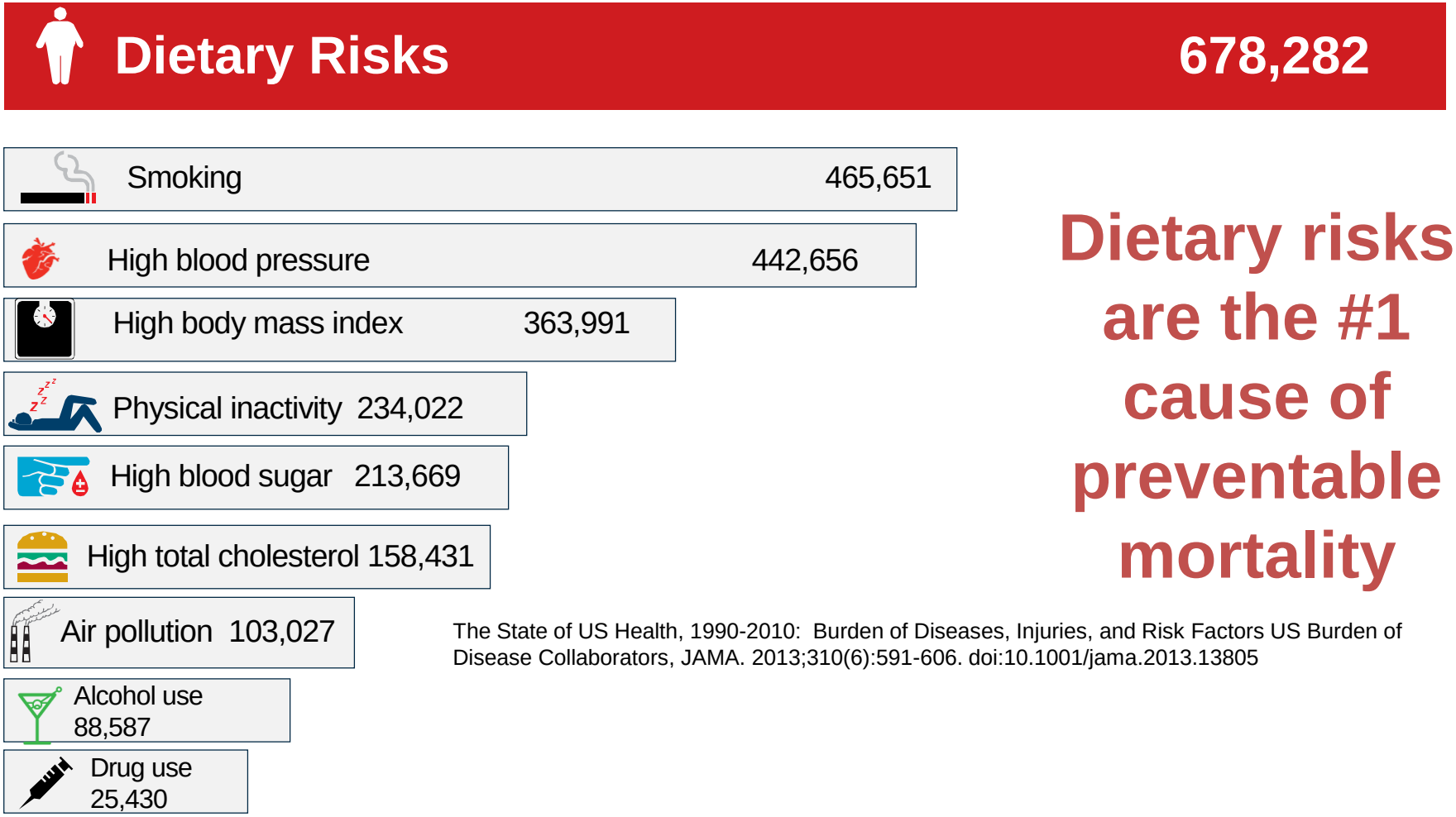
The relations of lifestyle, established and novel risk factors, and cardiovascular disease



Mozaffarian, D. Circulation. 2008, 117:3031-3038

Significant Potential for Dietary Change to Improve U.S. Health

Risk factors and corresponding deaths:

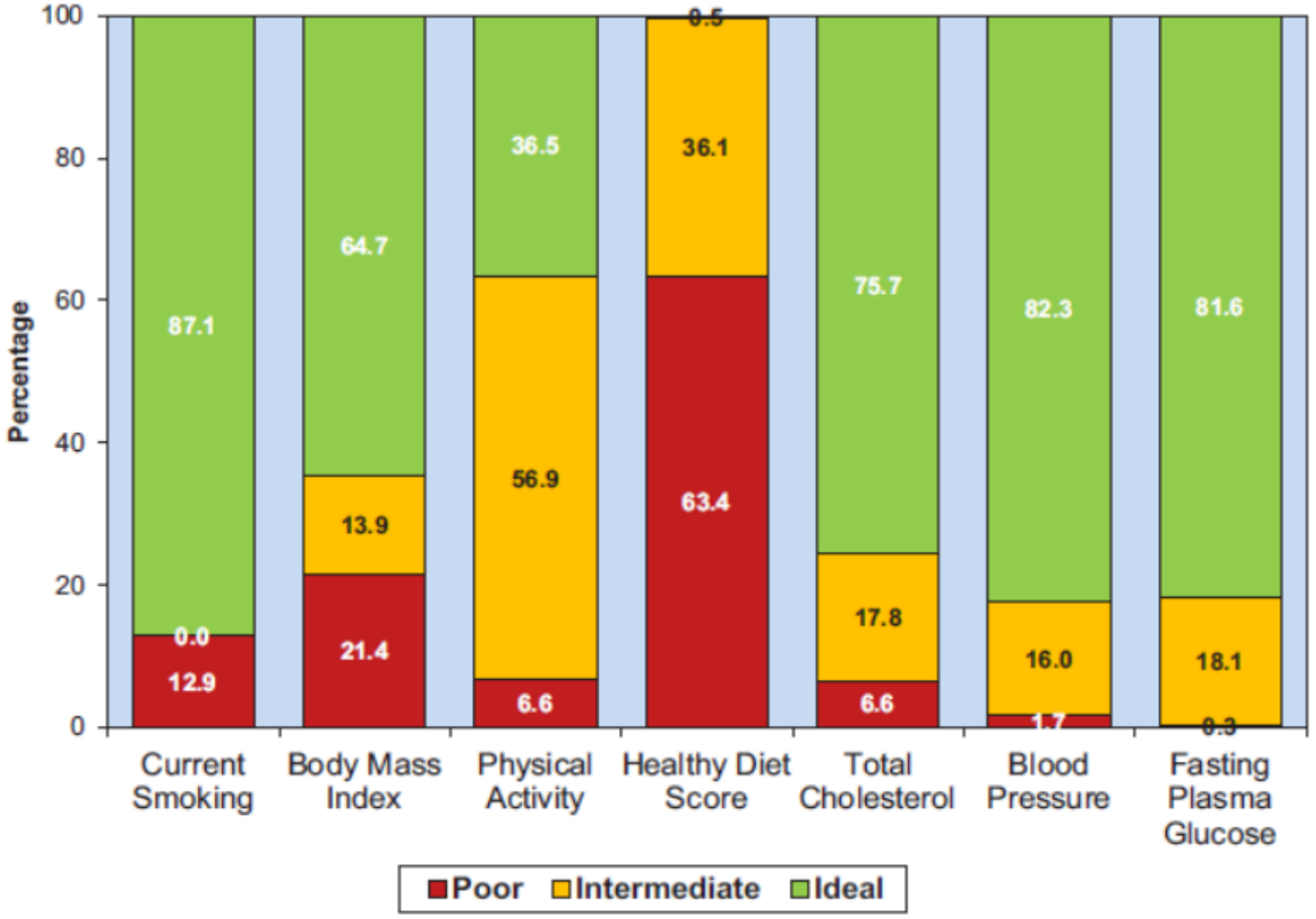


Dietary risks are the #1 cause of preventable mortality

The State of US Health, 1990-2010: Burden of Diseases, Injuries, and Risk Factors US Burden of Disease Collaborators, JAMA. 2013;310(6):591-606. doi:10.1001/jama.2013.13805

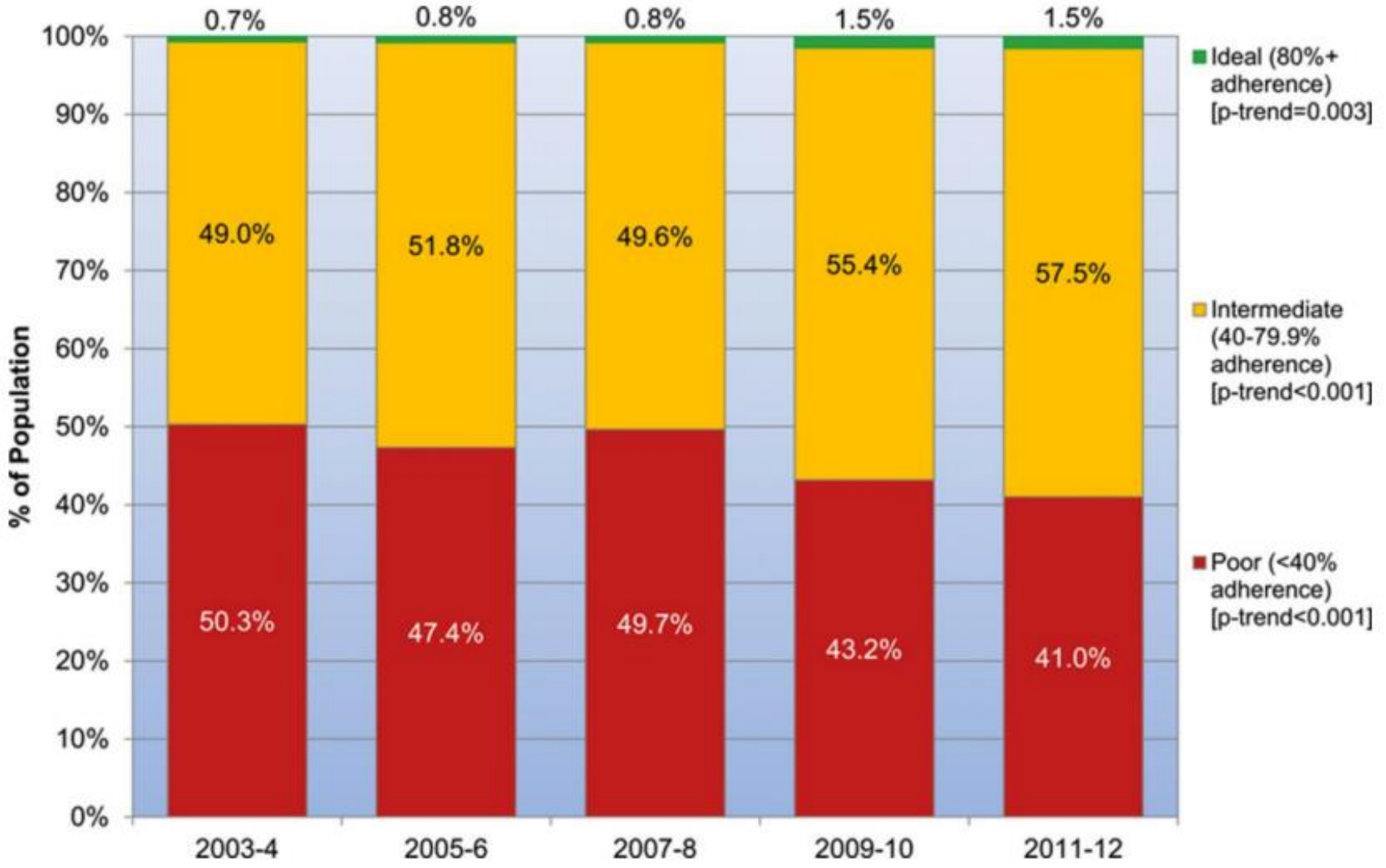
Prevalence (unadjusted) estimates for poor, intermediate and ideal cardiovascular health, US children aged 12-19 years

(NHANES 2011-2012)



Mozaffarian D et al. Published online in *Circulation* Dec. 16, 2015

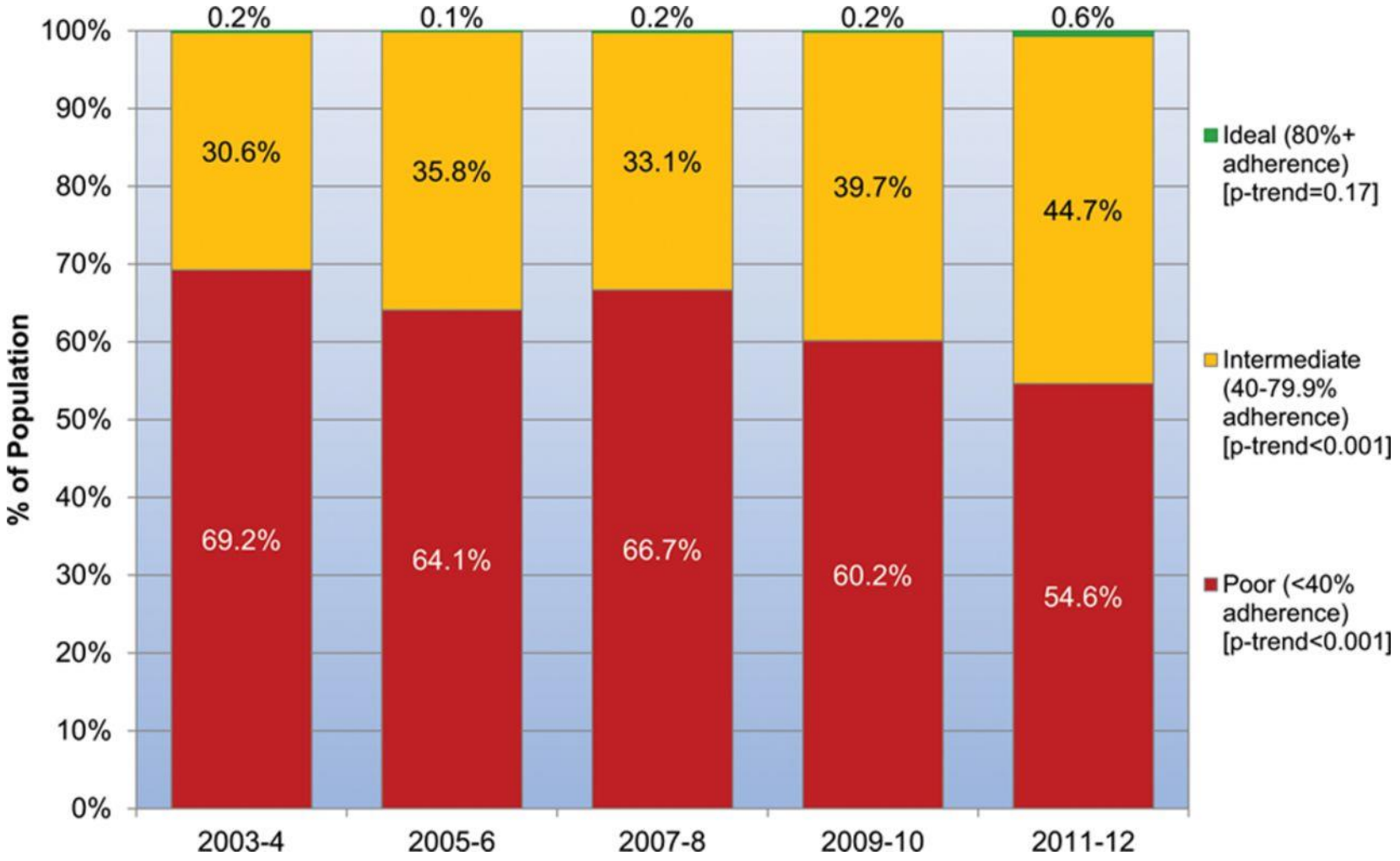
Healthy diet targets in adults (≥20 years of age) by survey year: National Health and Nutrition Examination Survey 2003 to 2004, 2005 to 2006, 2007 to 2008, 2009 to 2010, and 2011 to 2012.



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

American Heart Association.

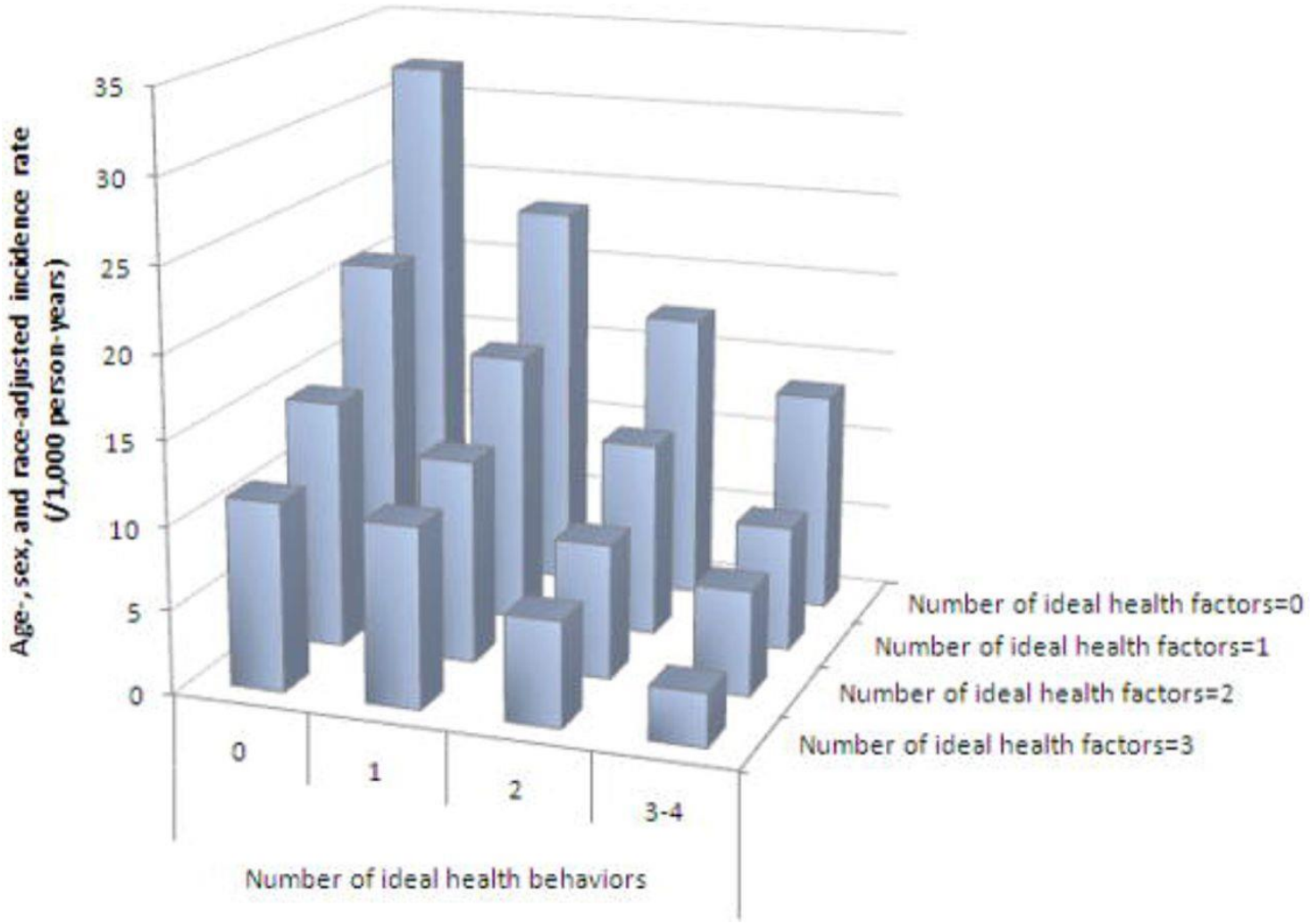
Healthy diet targets in children (5–19 years old) by survey year: National Health and Nutrition Examination Survey 2003 to 2004, 2005 to 2006, 2007 to 2008, 2009 to 2010, and 2011 to 2012.



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

American Heart Association.

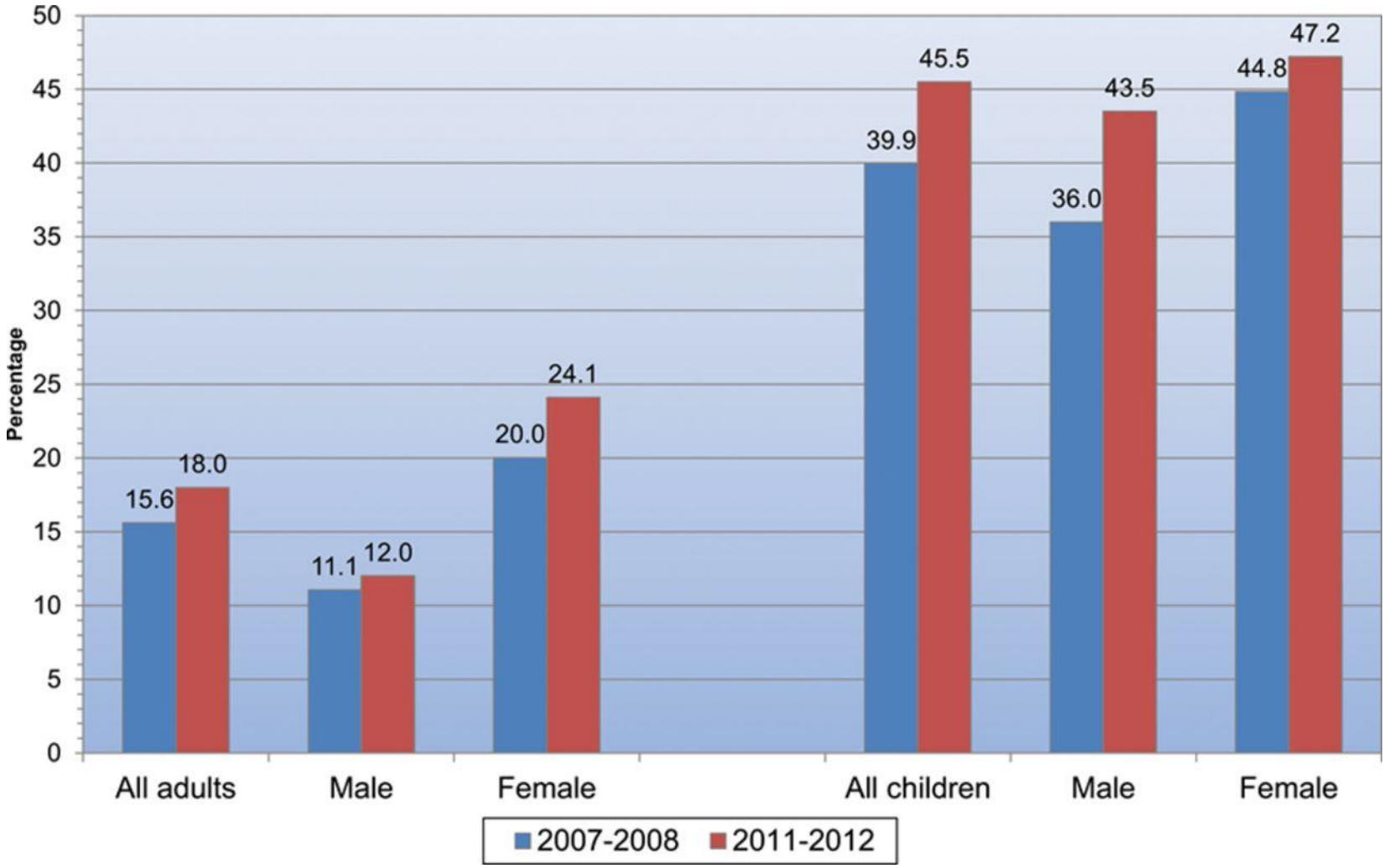
Incidence of cardiovascular disease according to the number of ideal health behaviors and health factors.



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

American Heart Association.

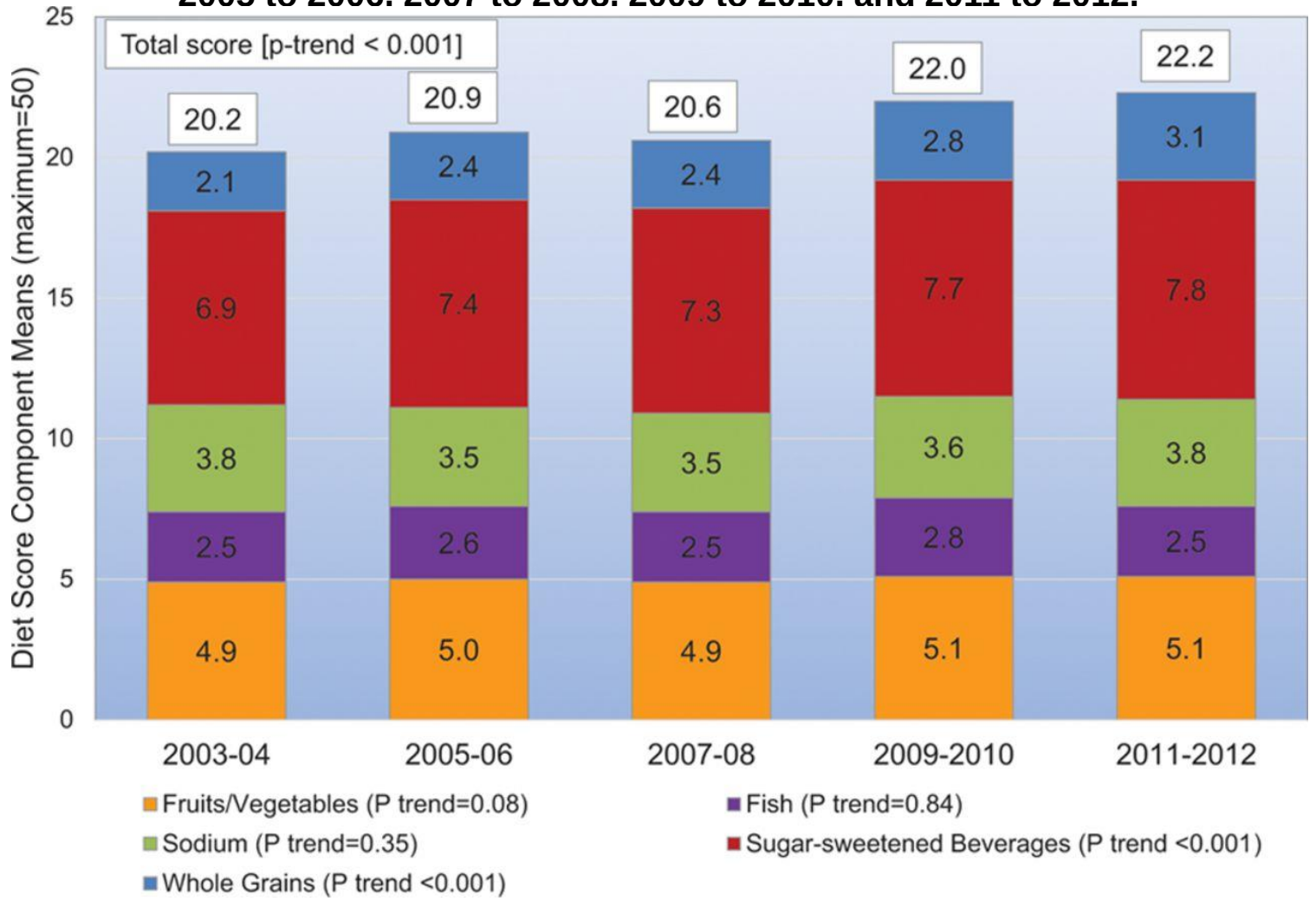
Prevalence of meeting ≥5 criteria for ideal cardiovascular health among US adults aged ≥20 years (age standardized) and US children aged 12 to 19 years, overall and by sex, National Health and Nutrition Examination Survey 2007 to 2008 and 2011 to 2012.



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

American Heart Association.

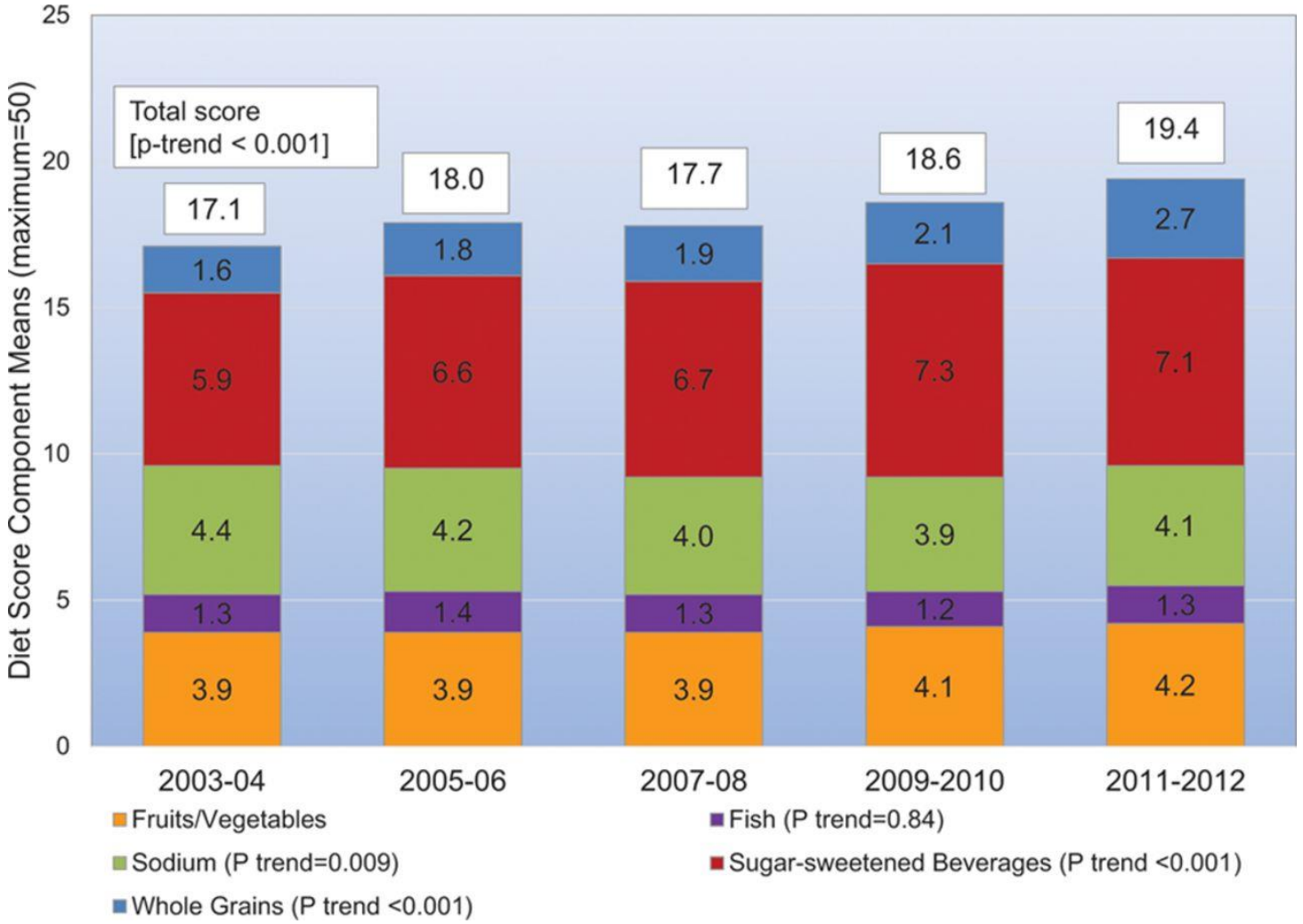
Trends in American Heart Association (AHA) healthy diet score components for adults (≥20 years of age) by survey year: National Health and Nutrition Examination Survey 2003 to 2004, 2005 to 2006. 2007 to 2008. 2009 to 2010. and 2011 to 2012.



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

American Heart Association.

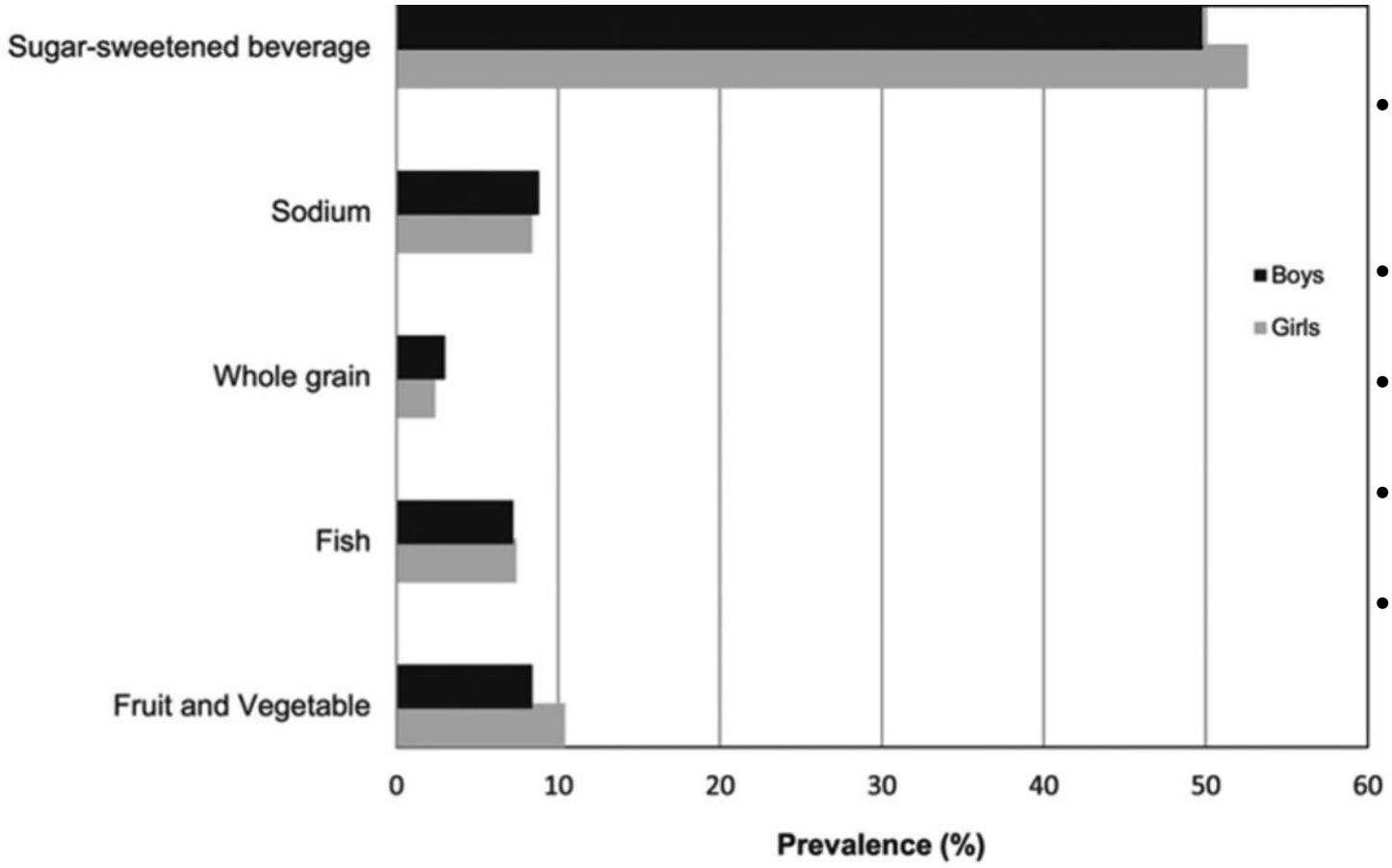
Trends in American Heart Association (AHA) defined healthy diet score components for children (5–19 years old) by survey year: National Health and Nutrition Examination Survey 2003 to 2004, 2005 to 2006, 2007 to 2008, 2009 to 2010, and 2011 to 2012.



Dariush Mozaffarian et al. Circulation. 2016;133:e38-e360

American Heart Association.

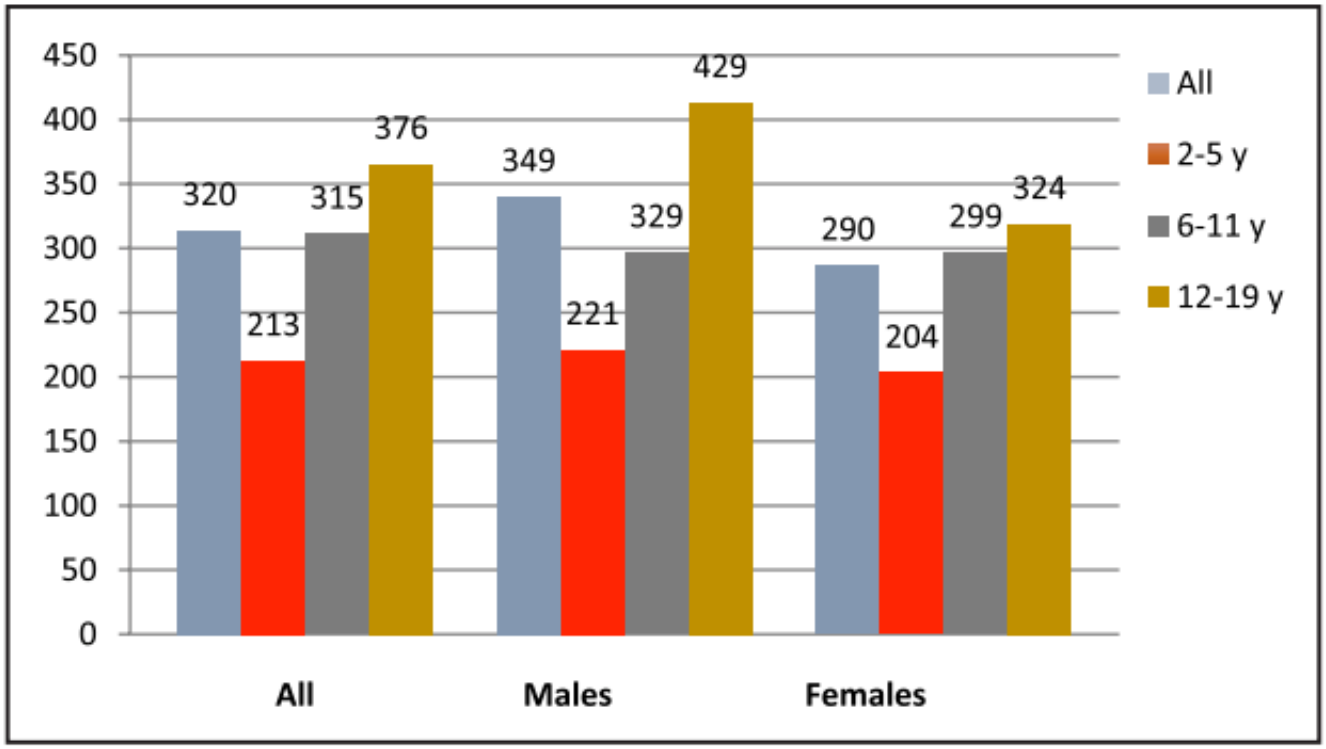
Prevalence of meeting the goal for individual components of the healthy diet score in US children 5 to 11 years: NHANES 2003 to 2010.



- Sugar-sweetened beverages: ≤ 450 kcal/week
- Sodium: <1500 mg/day
- Whole grain: ≥ three 1-oz servings/day
- Fish: ≥ two 3.5-oz servings/week
- Fruit and vegetable: ≥ 4.5 cups/day

Ning H et al. Circ Cardiovasc Qual Outcomes. 2015;8(2):164-171

Mean daily kilocalories from added sugars among children and adolescents 2 to 19 years of age, by sex and age group: NHANES, 2009 to 2012.



Vos MB et al. Circulation. 2016 Aug 22. [Epub ahead of print]

Summary

- Critical to control CVD risk factors in children to lower CVD risk in adulthood
- A healthy dietary pattern is a cornerstone for managing CVD risk factors throughout life
- The present U.S. diet for both children and adults falls WAY short of meeting current recommendations for heart health


Thank You

Stroke in Children

- The annual incidence of stroke in children ranges from 4.6 to 6.4 per 100,000 children.
- The prevalence of perinatal strokes is 29 per 100,000 live births, or one per 3,500 live births.
- Approximately half of all incident childhood strokes are hemorrhagic.
- Despite current treatment, 1 of 10 children with ischemic or hemorrhagic stroke will have a recurrence within 5 years.
- Among young adult survivors of childhood stroke, 37% had a normal range of disability, 42% had mild deficits, 8% had moderate deficits, and 15% had severe deficits.

Mozaffarian et al. Circulation. 2016; 133(4):e38-e360.

High Blood Pressure (HBP)

- In 2011 to 2012, 11.0% of children and adolescents aged 8 to 17 years had either HBP or borderline HBP.
- In 2011 to 2012, HBP was more common among boys (1.8%) than girls (1.4%) and among Hispanics than non-Hispanic blacks, non-Hispanic whites, and non-Hispanic Asians (1.7%).
- In 2003 to 2010, the distribution of poor, intermediate, and ideal BP among children 8 to 11 years of age was 2.8%, 4.8%, and 92.5%, respectively, among boys and 3.5%, 5.0%, and 91.5%, respectively, among girls.

Mozaffarian et al. Circulation. 2016; 133(4):e38-e360.

High Blood Cholesterol

- Among children age 6 to 11 years, the mean total blood cholesterol level is 160.2 mg/dL
- Among adolescents age 12 to 19 years, the mean total blood cholesterol level is 158.3 mg/dL
- Approximately 8.5% of adolescents have total cholesterol levels ≥200 mg/dL.
- Fewer than 1% of adolescents are eligible for pharmacological treatment on the basis of guidelines from the American Academy of Pediatrics.

Mozaffarian et al. Circulation. 2016; 133(4):e38-e360.

Overweight and Obesity

- 23.7 million children ages 2 to 19 are overweight or obese; 32.0% of boys and 31.6% of girls.
- Of these children, 12.6 million are obese; 16.7% of boys and 17.2% of girls.

Mozaffarian et al. Circulation. 2016; 133(4):e38-e360.

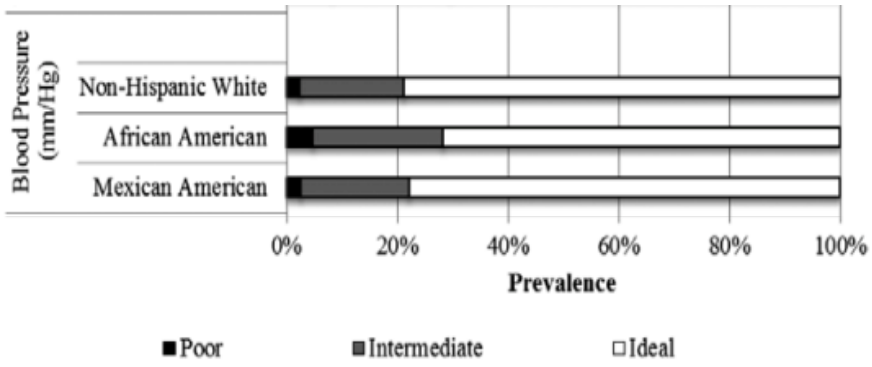
Diabetes

- Approximately 186,000 people under 20 years of age have diabetes. Each year, about 15,000 people under 20 years of age are diagnosed with type 1 diabetes.
- Health care providers are finding more and more children with type 2 diabetes. Children who develop type 2 diabetes are typically overweight or obese and have a family history of the disease. Most are American Indian, black, Asian, or Hispanic/Latino.
- During 2008 to 2009, an estimated 18,436 people <20 years of age in the United States were newly diagnosed with type 1 DM annually, and 5089 people <20 years old were newly diagnosed with type 2 DM annually.
- Between 2001 and 2009, the prevalence of type 2 DM in youth increased by 30.5%.
- Among adolescents 10–19 years of age diagnosed with diabetes, 57.8% of African Americans were diagnosed with type 2 versus type 1 diabetes, compared with 46.1% of Hispanic and 14.9% of Caucasian youth.
- Among youths with type 2 DM, 10.4% are overweight and 79.4% are obese.

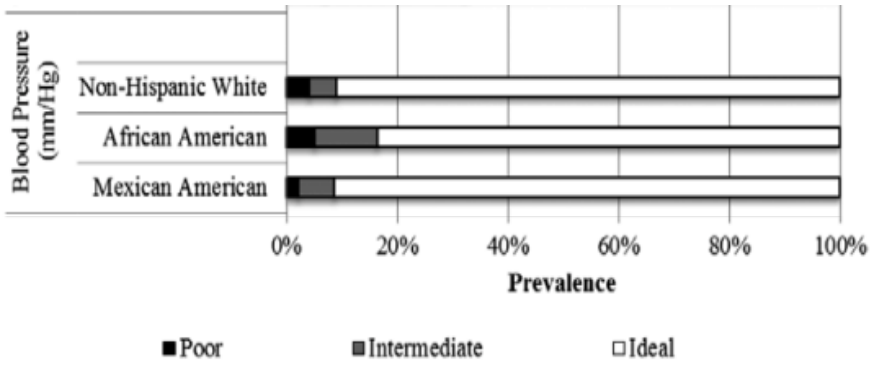
Mozaffarian et al. Circulation. 2016; 133(4):e38-e360.

Distribution of poor, intermediate, and ideal BP among adolescent males and females by race/ethnicity (aged 12–19 years): NHANES 2005–2010.

Males



Females

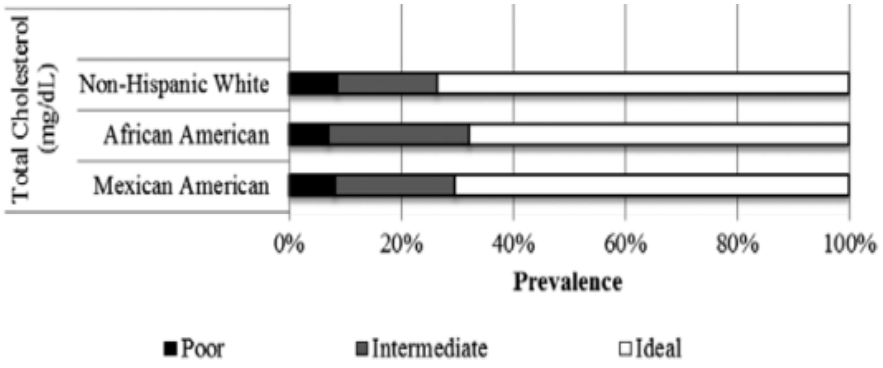


Blood pressure	(Males, n=2250)	(Females, n=2036)
Poor (>95th percentile)	2.9 (2.0–3.7)	3.7 (3–5)
Intermediate (90–95th percentile)	19.4 (16.3–22.6)	6 (5–8)
Ideal (<90th percentile)	77.7 (74.3–81.1)	90 (88–92)

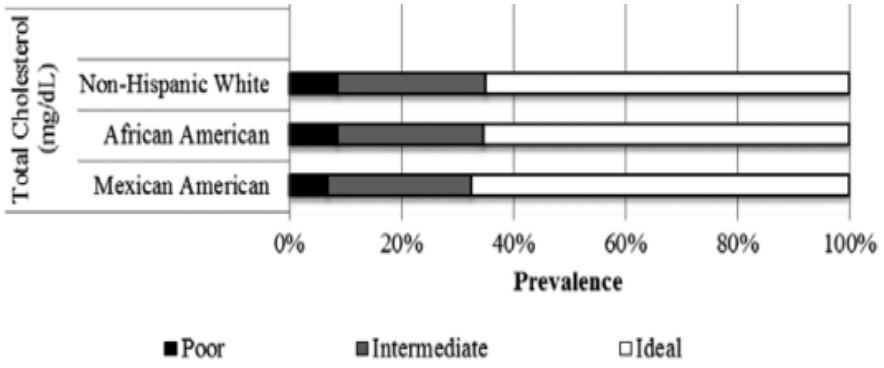
Shay et al. Circulation. 2013;127(13):1369-1376

Distribution of poor, intermediate, and ideal total cholesterol among adolescent males and females by race/ethnicity (aged 12–19 years): NHANES 2005–2010.

Males



Females



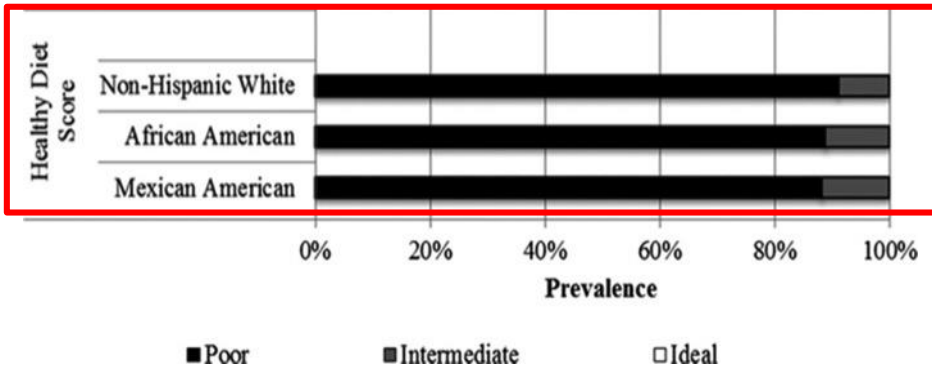
Total cholesterol	(Males, n=2191)	(Females, n=1981)
Poor (≥200 mg/dL)	8 (7–10)	8 (6–10)
Intermediate (170–199 mg/dL)	20 (17–22)	27 (24–30)
Ideal (<170 mg/dL)	72 (70–75)	65 (62–68)

Shay et al. Circulation. 2013;127(13):1369-1376

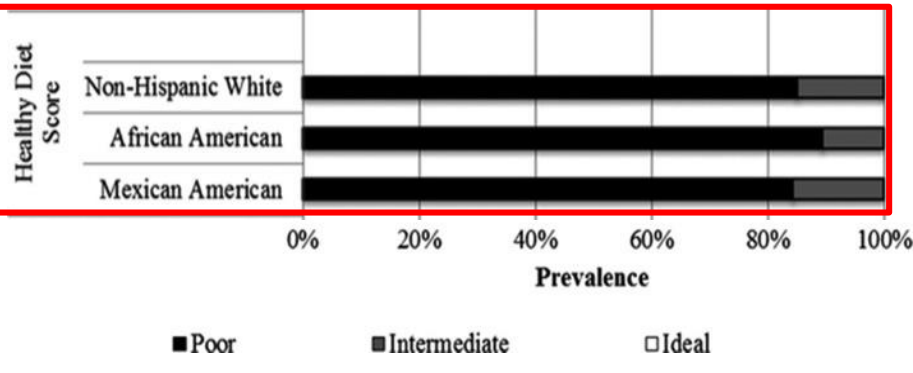
Prevalence of cardiovascular health behaviors and factors in adolescent males and females by race/ethnicity (aged 12–19 years): NHANES 2005–2010.

The Healthy Diet Score was the least favorable cardiovascular health component across all sex and race/ethnicity groups; >80% of adolescent males and females in all race/ethnicity groups were classified as having a poor Healthy Diet Score.

Males



Females



Shay et al. Circulation. 2013;127(13):1369-1376

Unadjusted prevalence of the metabolic syndrome and its components based on pediatric criteria from the IDF among U.S. adolescents aged 12–17 years, NHANES 1999–2004

	Sample size (*n*)	Metabolic syndrome†	Abdominal obesity†	High TG	Low HDL	High BP	Hyper-glycemia
Total participants	2,014	4.4 ± 0.6	27.3 ± 1.3	8.9 ± 1.0	22.6 ± 1.4	3.5 ± 0.6	10.6 ± 1.2
Age (years)							
12	709	1.0 ± 0.3	20.7 ± 2.2	8.9 ± 1.5	12.9 ± 2.2	1.2	10.1 ± 1.8
14	622	5.1 ± 1.0	25.6 ± 2.3	10.0 ± 1.6	18.6 ± 2.0	4.9 ± 1.2	14.2 ± 2.5
16–17	683	7.1 ± 1.3	35.5 ± 2.2	7.9 ± 1.4	36.1 ± 2.3	4.6 ± 1.0	7.9 ± 1.3
P for linear trend		<0.001	<0.001	0.635	<0.001	0.005	0.327
Sex							
Male	1,058	6.6 ± 1.3	18.5 ± 1.5	10.5 ± 1.6	23.4 ± 1.9	5.6 ± 0.9	15.3 ± 1.9
Female	956	2.1 ± 0.6	36.5 ± 2.2	7.3 ± 1.3	21.8 ± 2.1	1.3	5.8 ± 1.0)
P χ^2		0.008	<0.001	0.131	0.566	<0.001	<0.001
Ethnicity							
White	537	4.5 ± 0.8	25.9 ± 1.9	10.5 ± 1.5	25.1 ± 2.0	3.4 ± 0.8	11.6 ± 1.9
African American	637	2.7 ± 0.7	27.4 ± 1.9	3.6 ± 0.8	14.4 ± 1.9	5.0 ± 0.9	7.2 ± 1.1
Mexican American	700	6.6 ± 1.1	33.2 ± 1.9	10.8 ± 1.1	21.5 ± 1.6	2.5 ± 0.6	14.3 ± 1.8
P χ^2		0.012	0.043	<0.001	<0.001	0.040	0.003

† Metabolic syndrome and abdominal obesity defined using thresholds for waist circumference based on 90th percentiles from NHANES 1999–2004 data.

Ford et al. Diabetes Care 2008; 31(3): 587-589.