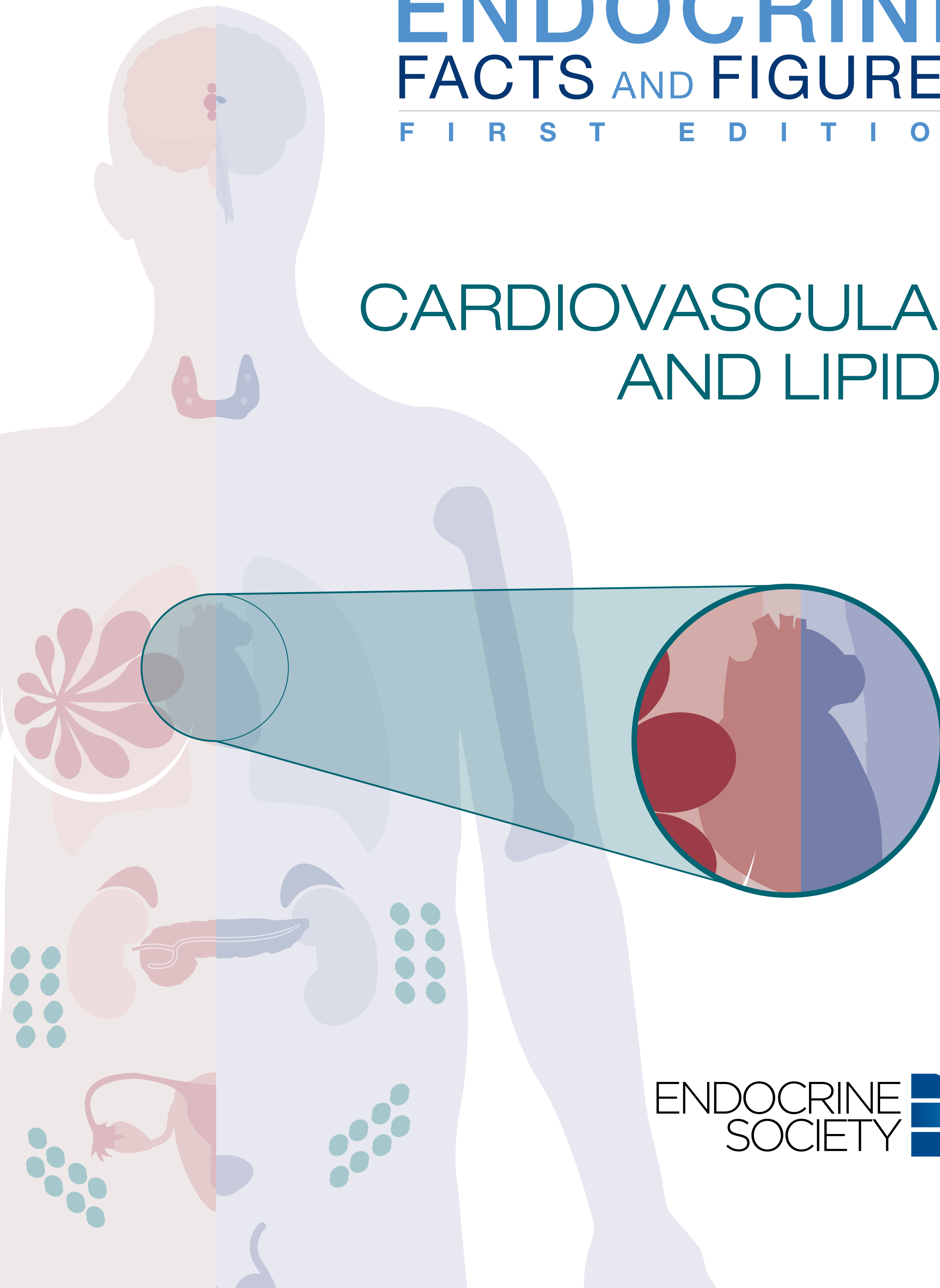
ENDOCRINE FACTS AND FIGURES

FIRST EDITION

CARDIOVASCULAR AND LIPIDS



ENDOCRINE SOCIETY

SEX DIFFERENCES IN US ADULTS AGE ≥20 YEARS

HYPERCHOLESTEROLEMIA | **HYPERTRIGLYCERIDEMIA**

Total cholesterol (>240 mg/dL)[4]

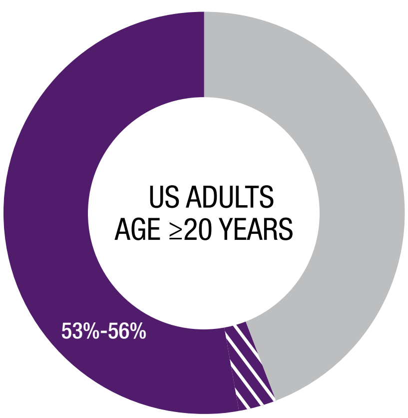
LDL-C*

HDL-C (≤40 mg/dL)[4]

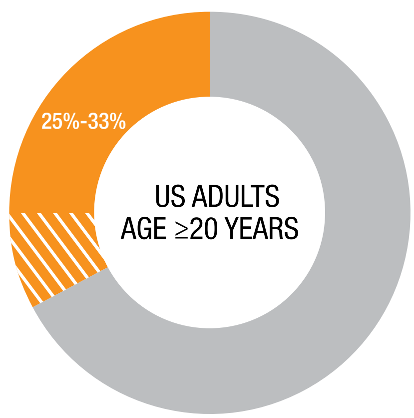
Triglycerides (≥150 mg/dL)[6]

* Cut-off values for high LDL-C vary depending on presence of coronary heart disease (CHD) and/or CHD risk.[5]

PREVALENCE



HYPERCHOLESTEROLEMIA[1]



HYPERTRIGLYCERIDEMIA[2]

COST BURDEN

$320.1 BILLION

TOTAL COST OF
CARDIOVASCULAR DISEASE
IN THE US, 2011[3]

INDIRECT MEDICAL COSTS[3]

2.8x

HIGHER IN MALES VS. FEMALES

6.2x

HIGHER IN ADULTS
<65 YEARS VS. ≥65 YEARS

Source:

1 Ford et al. Trends in hypercholesterolemia, treatment and controlamong United States adults. International Journal of Cardiology. 2010;Apr 15; 140(2):226-235.

2 Carroll et al. Trends in Elevated Triglyceride in Adults: United States, 2001-2012. NCHS Data Brief 2015.

3 Mozaffarian et al. Heart Disease and Stroke Statistics — 2015 Update: A Report From the American Heart Association. Circulation. 2015;131(4):e29-e322.

4 Carroll et al. Total and high-density lipoprotein cholesterol in adults: National Health and Nutrition Examination Survey, 2011-2012. NCHS Data Brief. 2013; Oct.(132):1-8.

5 Hyre et al. Trends in ATP-III-Defined High Blood Cholesterol Prevalence, Awareness, Treatment and Control Among U.S. Adults. Annals of Epidemiology. 2007;17(7):548-555.

6 Ford et al. Hypertriglyceridemia and its pharmacologic treatment among US adults. Archives of Internal Medicine. 2009;169(6):572-578.

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Mission Statement of the Endocrine Society

The mission of the Endocrine Society is to advance excellence in endocrinology and promote its essential and integrative role in scientific discovery, medical practice, and human health.

About Endocrine Facts and Figures

Endocrine Facts and Figures is a compendium of epidemiological data and trends related to a spectrum of endocrine diseases. The data is organized into nine chapters covering the breadth of endocrinology: Adrenal, Bone and Calcium, Cancers and Neoplasias, Cardiovascular and Lipids, Diabetes, Hypothalamic-Pituitary, Obesity, Thyroid, and Reproduction and Development.

All data is sourced from peer-reviewed publications, with an additional round of review by a group of world-renowned experts in the field. Additional oversight from the Endocrine Facts and Figures Advisory Panel ensured fair and balanced coverage of data across the therapeutic areas.

The first edition of **Endocrine Facts and Figures** emphasizes data on the United States. Future updates to the report will include additional data for other countries.

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For More Information

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Disclaimer

This publication summarizes current scientific information about epidemiology and trends data related to a spectrum of endocrine diseases. It is not a practice guideline or systematic review. Except when specified, this publication does not represent the official policy of the Endocrine Society.

I OVERVIEW

Cardiovascular and lipid disorders are the leading cause of mortality in the United States (US).[1] This chapter focuses on the epidemiology and trends data of hypercholesterolemia and hypertriglyceridemia, conditions that can considerably increase the risk of developing cardiovascular disorders (CVDs).

1.1

EPIDEMIOLOGY

Table 1 summarizes the prevalence of cardiovascular and lipid disorders covered in this chapter.

Data from NHANES 2003-2006 reported that in the US 53% of adults age ≥20 years had abnormal lipid profiles.[4,5] Table 2 presents detailed information on the prevalence of abnormal lipid profiles in the civilian, non-institutionalized, adult population in the US.

1.2

COST BURDEN OF DISEASE

In 2011, CVDs in the US accounted for $195.6 billion in direct costs (physicians and staff, hospital services, prescribed medication and home health care — excluding home nursing), and $124.5 billion in indirect costs (lost productivity due to absenteeism or premature deaths). In addition, indirect medical costs were substantially higher for males, and for those age <65 years (Table 3).[6]

The National Heart, Lung, and Blood Institute (NHLBI) estimated a 28% increase (from $5.9 million to $7.6 million) in the total cost of inpatient cardiovascular operations and procedures between 2000 and 2010.[6] In addition, the American Heart Association (AHA) predicts that by 2030, 40.5% of the US population will likely have some form of a CVD, and that the direct cost of treating CVDs will triple from $273 billion in 2010 to $818 billion in

Table 1

Prevalence of cardiovascular and lipid disorders in the United States.

CONDITION	DATA SOURCE	METHOD	POPULATION	PREVALENCE	REFERENCE
Hypercholesterolemia	NHANES 1999-2006	Cross-sectional survey	US, age ≥20 years (n=18,053)	53-56	Ford et al. 2010[2]
Hypertriglyceridemia	NHANES 2001-2004, 2009-2012	Cross-sectional survey	US, age ≥20 years (n=4,881)	25-33	Carroll et al. 2015[3]

Abbreviations: NHANES, National Health and Nutrition Examination Survey; US, United States; hypercholesterolemia defined by total cholesterol levels ≥200 mg/dL; hypertriglyceridemia defined by triglyceride levels ≥150 mg/dL.

Table 2

Prevalence of abnormal lipid profiles in adults, United States.

DATA SOURCE	POPULATION	ABNORMAL LIPID PROFILE	PREVALENCE (%)
NHANES 2003-2006	US, adults, age ≥20 years	Elevated LDL-C (risk-stratum specific)	27
		Depressed HDL-C (males, <40 mg/dL; females <50 mg/dL)	23
		Elevated TGs (≥200 mg/dL)	30
		Elevated non-HDL-C (≥130 mg/dL) and elevated TG (≥200 mg/dL)	13
		Mixed dyslipidemia (elevated LDL-C and depressed HDL-C and/or elevated TGs)	21
		Elevated LDL-C and depressed HDL-C and elevated TG	6
Source: Tóth et al. 2012[4]			

Abbreviations: LDL-C, low-density lipoprotein-cholesterol; HDL-C, high-density lipoprotein cholesterol; TG, triglycerides. Fasting blood serum levels are shown.

2030; with indirect costs expected to increase from $172 billion to $276 billion in the same time period.[7]

According to the Household Medical Expenditure Panel Survey (MEPS), National Center for Health Statistics (NCHS), and Institute for Health and Aging, five of the 23 highest direct health expenditures in 2011, in the US, were in the CVD diagnostic group, with heart disease ranking number one (direct health expenditure $116.3 million), and hyperlipidemia ranking number 10 (direct health expenditure $38.9 million). In total, the CVD diagnostic group accounted for $234.4 billion, or 23%, of the $1.02 trillion total direct US health expenditure costs for 2011.[6]

An observational cohort study in the US, analyzing the 2008 electronic medical records of 108,324 adults (age ≥18 years), estimated that the mean annual direct medical care cost of patients with severe hypertriglyceridemia (TG levels ≥500 mg/dL) was 38% higher per year ($8,567) than for subjects with normal TG levels (<150 mg/dL, $6,186).[8] According to an observational cohort study from 2004-2009, by the same lead authors, lowering TG levels by ≥60% in patients (n=808, mean age 55.9 years, 66% male) with severe hypertriglyceridemia (TG ≥500 mg/dL), reduced the mean annual baseline medical costs by $471.[9]

An observational claims study (2006-2013) monitoring severe hypertriglyceridemia (TG ≥500 mg/dL) in a commercially-insured US adult population of age 46-48 years (n=29,896), reported healthcare costs (mean all-cause medical and pharmacy costs) to be highest in patients with the highest TG levels: $8,850 in cohort TG ≥1500 mg/dL, $8,747 in cohort 750 ≤ TG <1500 mg/dL, and $8,305 in cohort 500 < TG <750 mg/dL. The mean all-cause costs per patient increased during a 360-day follow-up across all three hypertriglyceridemia cohorts to: $12,642 (43% increase), $11,504 (32% increase), and $10,683 (29% increase), respectively. Furthermore, acute pancreatitis events resulted in >300% increase in total all-cause costs.[10]

II HYPERLIPIDEMIA

Hyperlipidemia is defined as elevated levels of various lipids in the bloodstream. This section will focus on hypercholesterolemia and hypertriglyceridemia, both of which constitute major risk factors for CVDs.

HYPERCHOLESTEROLEMIA AND HYPERTRIGLYCERIDEMIA

Hypercholesterolemia is usually defined by the presence of one, or more of the following lipid abnormalities: elevated total cholesterol (TC) (200-239 mg/dL considered borderline-high risk, or ≥240 mg/dL considered high risk); elevated low-density lipoprotein cholesterol (LDL-C, >130 mg/dL); and elevated non-high density lipoprotein cholesterol (HDL-C, ≥145 mg/dL).[4,11,12]

Hypertriglyceridemia is a lipid abnormality characterized by elevated serum triglyceride (TG) levels (≥150 mg/dL), and is also a risk factor for CVD.[13]

Table 3

Cost of overall cardiovascular disorders by age and sex in the United States.

DATA SOURCE	POPULATION		TOTAL COSTS ($ BILLIONS)	DIRECT COSTS ($ BILLIONS)	INDIRECT COSTS ($ BILLIONS)
Household Medical Expenditure Panel Survey 2011, NCHS, and Institute for Health and Aging	US, based on 2011 data for cardiovascular disease or stroke	**Sex**			
		Males	190.4	99.0	91.4
		Females	129.7	96.6	33.1
		Age			
		<65 years	203.3	96.2	107.1
		Total	320.1	195.6	124.5

Source: Mozaffarian et al. 2015[6]

Abbreviations: NCHS, National Center for Health Statistics.

2.1
PREVALENCE AND INCIDENCE

According to a 2012 report, 42.2% of US adults are at moderate risk of developing hypercholesterolemia (TC ≥200 mg/dL), 13.1% are at high risk (TC ≥240 mg/dL) (Table 4), and another 6.2% of cases are thought to be undiagnosed.[6]

In 2008, a study of over 100,000 medical records of members of Kaiser Permanente Northwest, reported that approximately 36% of US adults presented with TG levels (≥150 mg/dL) that may lead to hypertriglyceridemia (Table 5).

2.2
DEMOGRAPHIC DIFFERENCES

The risk of developing hypercholesterolemia or hypertriglyceridemia is determined by a number of factors, including sex, race/ethnicity, age, weight classification status, education, healthcare, geography, and comorbidities.[11,14]

Table 6 summarizes data on sex differences in the prevalence of risk factors associated with hypercholesterolemia in US adults, children and adolescents. In brief, when assessing TC levels, females show a higher prevalence of the disease than their male counterparts, independently of age. These sex differences in hypercholesterolemia have been attributed to lower ideal physical activity in females (44%) than males (67%).[15] Interestingly, a Minnesota-based study, found the prevalence of hypercholesterolemia (TC ≥200 and ≥240 mg/dL) to be lower in females than males, presumably due to better regional education and healthcare among females.[14] On the contrary, males show a higher prevalence of elevated LDL-C and depressed HDL-C levels (Table 6).

Hypercholesterolemia due to elevated TC levels does not increase linearly with age. In fact, NHANES 1999-2000 data showed a peak in TC levels between 55-64 years (37.4%) in females but in a younger age group (45-54 years) in males (22.9%).[16]

Hypertriglyceridemia affects approximately a third of the US adult population. However, the severe form (TG ≥500 mg/dL) is rare, affecting less than 2% of the US population.[20,21] A breakdown of the TG levels in a 2001-2006 NHANES study of US adults (n=5,680, age ≥20 years) extrapolated that while 14.2% of the US population

Table 4

Prevalence of elevated total cholesterol and hypercholesterolemia in the United States.

DATA SOURCE	POPULATION	CATEGORY	PREVALENCE (%)
NHANES 2009-2012 (extrapolated for 2012)	US, adults, age ≥20 years	Elevated total cholesterol (TC ≥200 mg/dL)	42.2
		Hypercholesterolemia (TC ≥240 mg/dL)	13.1

Source: Mozaffarian et al. 2015[6]

Note: NHANES defines adult cholesterol levels ≥240 mg/dL as poor, and 200-239 mg/dL as intermediate.

Table 5

Prevalence of cardiovascular and lipid disorders in the United States.

DATA SOURCE	POPULATION	METHOD	HYPERTRIGLYCERIDEMIA	PREVALENCE (%)
Members of Kaiser Permanente Northwest, 2008	US, adults (age ≥18 years) (n=108,324)	Observational cohort study of electronic medical records	Borderline-high risk (TG 150-199 mg/dL)	16.4
			High risk (TG 200-499 mg/dL)	18.0
			Severe hypertriglyceridemia (TG ≥500 mg/dL)	1.5

Source: Nichols et al., 2011[8]

Abbreviations: TG, triglycerides.

Table 6

Sex differences in risk factors associated to hypercholesterolemia the United States.							
					PREVALENCE (%)		
LIPID PROFILE	DATA SOURCE	POPULATION	LIPID LEVEL	TOTAL	MALES	FEMALES	REFERENCE
TC*	NHANES 1999-2000	US, adults, age ≥20 years (n=4,148)	TC ≥200 mg/dL	50.5	49.7	51.1	Ford et al. 2003[16]
			TC ≥240 mg/dL	17.8	16.7	18.7	
	NHANES 2011-2012	US, adults, age ≥20 years (n=3469)	TC ≥200 mg/dL	NR	NR	NR	Carroll et al. 2013[17]
			TC ≥240 mg/dL	12.9	11.1	14.4	
	Minnesota Heart Survey (MHS) 2000-2002	US, adults, age 25-84 years (n=1,352)	TC ≥200 mg/dL	50.0	54.9	46.5	Arnett et al. 2005[14]
			TC ≥240 mg/dL	20.0	23.9	17.3	
	NHANES 2005-2010	US, children, age 12-19 years (n=4,673)	TC 170-199 mg/dL	25	20	27	Shay et al. 2013[15]
			TC ≥200 mg/dL	8	8	8	
	NHANES 2011-2012	US children, age 8-17 years (n=1,482)	TC ≥200 mg/dL	7.8	NR	NR	Kit et al.2015[18]
LDL-C**	NHANES 1999-2004	US, adults, age ≥20 years (n=1,628)	LDL-C	25.3	29.9	21.1	Hyre et al. 2007[5]
	NHANES 2009-2012	US, adolescents age 12-19 years	LDL-C	NR	7.1	7.4	Mozaffarian et al. 2015[6]
HDL-C	NHANES 2011-2012	US, adults, age ≥20 years, (n=3,469)	HDL-C ≤40 mg/dL	17.0	26.4	9.0	Carroll et al. 2013[17]
	NHANES 2011-2012	US, children and adolescents age 8-17 years (n=1,482)	HDL-C <40 mg/dL	12.8	NR	NR	Kit et al. 2015[18]

Note: *, The American Heart Association defines Intermediate risk of hypercholesterolemia TC ≥200 mg/dL in adults, or ≥170 mg/dL in children and adolescents; high risk as TC ≥240 mg/dL in adults or ≥200 mg/dL in children and adolescents.[19]; ** High LDL-C levels warranting therapeutic lifestyle changes and consideration of lipid-lowering therapy are specified by the National Cholesterol Education Program Adult Treatment Panel –III guidelines as ≥100 mg/dL for patients with coronary heart disease (CHD) and/or CHD risk equivalent(s). For patients without CHD or risk equivalent, high LDL-C is defined as LDL-C levels ≥130 mg/dL for patients with two or more CHD risk factors and a 10-year CHD risk of 10-20%, ≥160 mg/dL for patients with two or more CHD risk factors and a 10-year CHD risk <10%, and ≥190 mg/dL for patients with 0-1 CHD risk factors. A person with high LDL-C is defined as having LDL-C levels stated above, or if taking cholesterol-lowering medication.[5]

Abbreviations: NR, not reported.

had borderline-high TG levels (150-200 mg/dL), 16.3% had high TG levels (200 to <500 mg/dL), 1.7% had severe levels (500-2,000 mg/dL), and 0.0004% had very severe TG levels (>2,000 mg/dL).[22]

In addition, NHANES data indicates that hypertriglyceridemia is more common in males than females, regardless of age (Table 7).

Elevated triglyceride levels in the US population increase with age to peak between 40-59 years of age, with little change thereafter (Table 8).

Several US studies examining lipid abnormalities by race/ethnicity and sex have reported elevated TC and depressed HDL-C level to be highest in Hispanic/Latinos and lowest in blacks (Table 9).[17] In addition, elevated LDL-C is reported to be highest in whites and lowest in Mexican/Americans (Table 9).[5]

Risk factors for hypercholesterolemia and hypertriglyceridemia have been declining in the last two to three decades in children, adolescents, and adults (Table 10). The favorable changes in lipid levels in the US over time are suggested to be due to a combination of factors, including healthier diet and lifestyles and increase in the use of statin monotherapy.[3]

Geographical differences in the prevalence of hypercholesterolemia have also been reported in the US. A 2009 household survey of 9,612 adults (age ≥20 years) in a rural region in Upstate New York, (adjusted for age, sex, and education) found male farmers had significantly lower prevalence of hypercholesterolemia (odds ratio, OR, 0.7) than rural non-farm residents, but not lower prevalence of heart disease or stroke. Although the farmers had worse health behaviors such as screening, vaccinations, regular health care provider; the lower hypercholesterolemia rates were presumably due to lower

Table 7

Prevalence of hypertriglyceridemia by sex in the United States.

DATA SOURCE	POPULATION	LEVEL OF HYPERTRIGLYCERIDEMIA	PREVALENCE (%) TOTAL	MALES	FEMALES	REFERENCE
NHANES 1994-2004	US adults, age ≥20 years (n=5,610)	Hypertriglyceridemia (TG ≥150 mg/dL)	33.1	36.7	29.6	Ford et al. 2009[20]
		Hypertriglyceridemia (TG ≥200 mg/dL)	17.9	21.5	14.4	
		Severe hypertriglyceridemia (TG ≥500 mg/dL)	1.7	2.8	0.8	
		Very severe hypertriglyceridemia (TG ≥1000 mg/dL)	0.4	NR	NR	
NHANES 1999-2006	US, adolescents, age 12-19 years (n=270)	Hypertriglyceridemia (TG ≥150 mg/dL)	10.2	11.4	8.8	Centers for Disease Control and Prevention. 2010[23]
NHANES 2009-2012	US, adolescents, age 12-19 years	Hypertriglyceridemia (TG ≥150 mg/dL)	NR	10.0	6.5	Mozaffarian et al. 2015[6]

Abbreviations: TG, triglycerides; NR, not reported.

Table 8

Elevated Triglyceride levels (≥150 mg/dL) by age in the United States.

DATA SOURCE	POPULATION	AGE	PREVALENCE (%)
NHANES 2009-2012	US, adults, age ≥20 years (n=4,881)	20-39 years	19.9
		40-59 years	28.8
		≥60 years	28.2

Source: Carroll et al. 2015[3]

rates of smoking (OR 0.6) and higher physical labor (OR 2.61).[24]

2.3

LIFE EXPECTANCY AND MORTALITY

According to the Centers for Disease Control and Prevention (CDC), the death rate in the US from CVDs declined by 29% from 1999 (30.3%) to 2013 (23.5%); however, CVDs remain the number one cause of mortality in the US, accounting for 611,105 of the 2,596,993 all-cause deaths in 2013.[25] The declining death rate reflects favorable changes in the lipid levels in the US (as shown in Demographic Differences section above). Data from NHANES 1988-1994 (n=16,573) and 2007-2010 (n=11,766), in US adults, showed favorable decreases, over the 22-year time period, in serum levels of TC (206 to 196 mg/dL), LDL-C (129 to 116 mg/dL), non-HDL-C (155 to 144 mg/dL) and TGs (118 to 100 mg/dL), as well as favorable increases in HDL-C (50.7 to 52.5 mg/dL) and the use of lipid lowering medication (3.4% to 15.5%).[26]

2.4

KEY TRENDS AND HEALTH OUTCOMES

Based on analysis of data collected in the cross-sectional NHANES 1996 to 2006, the prevalence of hypercholesterolemia in US adults remained stationary from 1999 (53.2%) to 2006 (56.1%) (Table 11).[2] In addition, only 50% of patients at borderline high risk were aware of their elevated cholesterol levels, and the condition was controlled by medications in fewer than 20%.

Analysis of NHANES data from 1999 to 2004 showed a gradual increase in the use of cholesterol-lowering medication and in improvements in controlling hypercholesterolemia to the target lipid levels with medication (Table 12).

A decrease in the prevalence of CVDs in the last two decades is partially attributed to increased use of lipid-lowering drugs. Key findings from NHANES 2003 to 2012 in adults age >40 years showed a steady increasing trend

Table 9

Prevalence of hypercholesterolemia and hypertriglyceridemia in adults by race/ethnicity in the United States.

LIPID DISORDER	DATA SOURCE	POPULATION	CATEGORY/ETHNICITY	PREVALENCE (%)	REFERENCE
Hypercholesterolemia	NHANES 2011-2012	US, adults, age ≥20 years (n=3,469)	**TC ≥240 mg/dL**		Carroll et al. 2013[17]
			White (NH)	13.5	
			Black (NH)	9.8	
			Asian (NH)	10.3	
			Hispanic	14.2	
	NHANES 1999-2004	US, adults, age ≥20 years (n=1,628)	**LDL-C ≥130 mg/dL**		Hyre et al. 2007[5]
			White (NH)	26.9	
			Black (NH)	17.2	
			Mexican-Americans	16.5	
	NHANES 2011-2012	US, age ≥20 years (n=3,469)	**HDL-C <40 mg/dL**		Carroll et al. 2013[17]
			White (NH)	17.1	
			Black (NH)	12.7	
			Asian (NH)	14.3	
			Hispanic	21.8	
Hypertriglyceridemia	NHANES 1999-2004	US, adults, age ≥20 years (n=5,610)	**TGs ≥150 mg/dL**		Ford et al. 2009[20]
			White (NH)	35.3	
			Black (NH)	16.3	
			Mexican-Americans	37.9	

Abbreviations: TC, total cholesterol; LDL-C low-density lipoprotein cholesterol; NH, non-Hispanics.

Table 10

Declining trends in risk factors for hypercholesterolemia and hypertriglyceridemia in the United States.						
LIPID DISORDER	DATA SOURCE	POPULATION	LIPID PROFILE	PREVALENCE (%)		REFERENCE
Hypercholesterolemia	NHANES 1976-1980 to 2007-2010	US, adults, age ≥20 years (n=7,044)		**1976-1980**	**2007-2010**	Kuklina et al. 2009[21]
			LDL-C*	59	27	
	NHANES 1999-2000 to 2011-2012	US, children and adolescents, age 8-17 years (n=1,482)		**1999-2000**	**2011-2012**	Kit et al. 2015[18]
			TC (≥200 mg/dL)	10.6	7.8	
			HDL-C (≤40 mg/dL)	17.9	12.8	
			non-HDL-C (≥145 mg/dL)	13.6	8.4	
Hypertriglyceridemia	NHANES 2001-2004 to 2009-2012	US, adults, age ≥20 years (n=4,115 for 2001-2004; n=4,881 for 2009-2012)		**2001-2004**	**2009-2012**	Carroll et al. 2015[3]
			TG (≥150 mg/dL)	33	25	

Note: *, High LDL-C ≥100 mg/dL for patients with coronary heart disease (CHD) and/or CHD risk equivalent(s), ≥130 mg/dL for patients with two or more CHD risk factors and a 10-year CHD risk of 10-20%, ≥160 mg/dL for patients with two or more CHD risk factors and a 10-year CHD risk <10%, and ≥190 mg/dL for patients with 0-1 CHD risk factors. A person with high LDL-C is defined as having LDL-C levels stated above or if taking cholesterol-lowering medication.[5]

Table 11

Prevalence of checks, awareness, treatment, and control of hypercholesterolemia in the United States.				
DATA SOURCE	POPULATION	HYPERCHOLESTEROLEMIA	PREVALENCE (%)	
NHANES 1999 to 2006	US, adults age ≥20 years, unadjusted (n=18,053)	**TC ≥200 mg/dL**	**1999**	**2006**
		Cholesterol checked	68.6	74.8
		Awareness of condition	42.0	50.4
		Condition treated	39.1	54.4
		Condition controlled	7.2	17.1
		TC ≥240 mg/dL	**1999**	**2006**
		Awareness of condition	65.4	74.6
		Condition treated	55.7	70.9
		Condition controlled	27.6	44.2

Source: Ford et al. 2010[2]

from 20% to 28% in the use of cholesterol lowering drugs, and from 18% to 26% in the use of statins. In subjects with hypercholesterolemia, 54% were taking cholesterol-lowering medications in 2012.[28]

Although statins lower vascular morbidity and mortality in patients with hyperlipidemia, 10-15% of patients reported experiencing increased incidence of myalgia.[29] In fact, statin intolerance was reported in 5-20% of patients, and discontinuation of treatment was common, especially in patients on high-intensity statins.[29] Alternative therapies under investigation include PCSK9 inhibitors, which prevent the binding of PCSK9 to the LDL receptor. PCSK9 inhibitors appear to have milder side-effects than statins, although further data on safety, morbidity, and mortality are still pending from long-term clinical trials.[29] Importantly, the FDA recently approved the use of PCSK9 inhibitors alirocumab and evolocumab in July and August 2015 respectively.

While hypertriglyceridemia (TG ≥150 mg/dL) is common in the US population, the use of available prescription medications is low, as highlighted by a 5-year cross-sectional study (Table 13).

Therapeutic options in patients with mild-moderate hypertriglyceridemia (TG 150-500 mg/dL) include the use of statins to reduce levels of LDL-C and TGs, and the risk of CVDs. A recent retrospective cohort analysis also suggested decreased incidence of pancreatitis in association with statin use[30],but these patients are generally not at high risk of pancreatitis, unlike those with severe hypertriglyceridemia (>500 mg/dL), who may additionally require treatment with long-chain omega-3 fatty acids, fibrates or niacin.[31] Currently available therapies for hypertriglyceridemia are highlighted in Table 14.

Table 12

Lipid-lowering treatments for hypercholesterolemia in the United States.

DATA SOURCE	POPULATION	TREATMENT	PREVALENCE (%)
NHANES 1999-2000	US, adults, age ≥20 years (n=1,770)	Statin use (LDL-C in statin users: 119 mg/dL)	19.6
		Control target of LDL-C achieved*	49.7
NHANES 2001-2002	US, adults, age ≥20 years (n=2,094)	Statin use (LDL-C in statin users: 112 mg/dL)	27.3
		Control target of LDL-C achieved*	67.4
NHANES 2003-2004	US, adults, age ≥20 years (n=1,911)	Statin use (LDL-C in statin users: 100.7 mg/dL)	35.9
		Control target of LDL-C achieved*	77.6

Source: Mann et al. 2008[27]

Note: *, National Cholesterol Education Program Adult Treatment Panel –III guidelines for LDL-C control recommend the following targets: <100 mg/dL, <130 mg/dL, and <160 mg/dL for persons with high, intermediate, and low risk for developing coronary heart disease during the next ten years, respectively.[5]

Table 13

Percentage of hypertriglyceridemia patients receiving treatment in the United States.

DATA SOURCE	POPULATION	TRIGLYCERIDE LEVELS	PREVALENCE (%)	PERCENTAGE OF PATIENTS USING 1 OF 3 HYPERTRIGLYCERIDEMIA TREATMENTS (FENOFIBRATE, GEMFIBROZIL, OR NIACIN)
NHANES 1999-2004	US adults, age ≥20 years (n=5,610)	≥150 mg/dL	33.1	2.6
		≥200 mg/dL	17.9	3.6

Source: Ford et al. 2009[20]

Table 14

Health outcomes of lipid-lowering therapies for treatment of hypertriglyceridemia in the United States.				
DATA SOURCE	POPULATION	TREATMENT	OUTCOME	REFERENCE
Randomized, double-blinded, crossover design, hospital	US, adults age 19-59 years, Moderately hypertriglyceridemic and modestly hypercholesterolemic, normal LDL (n=11; 8 male, 3 female)	Fenofibrate	TG reduced by 45%, TC reduced by 14%, no changes in HDL or LDL	Capell et al. 2003[32]
Multinational, double-blind, randomized, out-patient study-EVOLVE trial 2011-2012	US adults, age ≥18 years, 3:1 ratio male:female, severe hypertriglyceridemia, TG ≥500-<2000 mg/dL (n=399)	Omega-3 carboxylic acids (OM3-CA)	TG reduced by 25.5-30.9%	Kastelein et al. 2014[33]
Retrospective cohort study 2006-2012, integrated healthcare system	US, adults, age ≥18 years, TG 200-500 mg/dL (n=707,236)	Simvastatin or atorvastatin	Statins reduced the risk of acute pancreatitis: incidence rate ratio RR= 0.6 or when adjusted RR=0.29	Wu et al. 2015[30]
Randomized, controlled, double-blind 6-week trial	US, mean age 60.8 years, 95.3% used a statin, TG≥200 mg/dL (n=647)	Omega-3 carboxylic acids (OM3-CA)	TG reduced by 14.6-20.6%	Dunbar et al. 2015[34]
Placebo-controlled study	US, severe hypertriglyceridemia, TG≥200 mg/dL	Omega-3 carboxylic acids (OM3-CA)	TG reduced by 25-30%	Zhao et al. 2015[35]

REFERENCES

1. World Health Organization. Cardiovascular diseases (CVDs) Fact sheet N°317 [webpage]. 2015; http://www.who.int/mediacentre/factsheets/fs317/en/.
2. Ford ES, Li C, Pearson WS, Zhao G, Mokdad AH. Trends in hypercholesterolemia, treatment and control among United States adults. Int, J. Cardiol. 2010;Apr 15; 140(2):226-235.
3. Carroll MD, Kit BK, Lacher DA. Trends in Elevated Triglyceride in Adults: United States, 2001-2012. NCHS Data Brief 2015; http://www.cdc.gov/nchs/data/databriefs/db198.htm. Accessed September 2015.
4. Tóth PP, Potter D, Ming EE. Prevalence of lipid abnormalities in the United States: The National Health and Nutrition Examination Survey 2003–2006. Journal of Clinical Lipidology. 2012;6(4):325-330.
5. Hyre AD, Muntner P, Menke A, Raggi P, He J. Trends in ATP-III-Defined High Blood Cholesterol Prevalence, Awareness, Treatment and Control Among U.S. Adults. Annals of Epidemiology. 2007;17(7):548-555.
6. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, de Ferranti S, Després J-P, Fullerton HJ, Howard VJ, Huffman MD, Judd SE, Kissela BM, Lackland DT, Lichtman JH, Lisabeth LD, Liu S, Mackey RH, Matchar DB, McGuire DK, Mohler ER, Moy CS, Muntner P, Mussolino ME, Nasir K, Neumar RW, Nichol G, Palaniappan L, Pandey DK, Reeves MJ, Rodriguez CJ, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Willey JZ, Woo D, Yeh RW, Turner MB. Heart Disease and Stroke Statistics—2015 Update: A Report From the American Heart Association. Circulation. 2015;131(4):e29-e322.
7. Heidenreich PA, Trogdon JG, Khavjou OA, Butler J, Dracup K, Ezekowitz MD, Finkelstein EA, Hong Y, Johnston SC, Khera A, Lloyd-Jones DM, Nelson SA, Nichol G, Orenstein D, Wilson PWF, Woo YJ. Forecasting the future of cardiovascular disease in the United States: a policy statement from the American Heart Association. Circulation. 2011;123(8):933-944.
8. Nichols GA, Arondekar B, Garrison LP, Jr. Patient characteristics and medical care costs associated with hypertriglyceridemia. American Journal of Cardiology. 2011;Jan 15;107(2):225-229.
9. Nichols GA, Arondekar B, Jacobson TA. Hospital use and medical care costs up to 5 years after triglyceride lowering among patients with severe hypertriglyceridemia. Journal of Clinical Lipidology. 2012;6(5):443-449.
10. Toth PP, Grabner M, Ramey N, Higuchi K. Clinical and economic outcomes in a real-world population of patients with elevated triglyceride levels. Atherosclerosis. 2014;237(2):790-797.
11. Dai S, Yang Q, Yuan K, Loustalot F, Fang J, Daniels SR, Hong Y. Non-high-density lipoprotein cholesterol: distribution and prevalence of high serum levels in children and adolescents: United States National Health and Nutrition Examination Surveys, 2005-2010. J ournal of Pediatrics. 2014;Feb;164(2):247-253.
12. Andersson C, Lyass A, Vasan RS, Massaro JM, D'Agostino RB, Sr., Robins SJ. Long-term risk of cardiovascular events across a spectrum of adverse major plasma lipid combinations in the Framingham Heart Study. American Heart Journal. 2014;Dec;168(6):878-883.
13. Pejic RN, Lee DT. Hypertriglyceridemia. The Journal of the American Board of Family Medicine. 2006;19(3):310-316.
14. Arnett DK, Jacobs DR, Luepker RV, Blackburn H, Armstrong C, Claas SA. Twenty-Year Trends in Serum Cholesterol, Hypercholesterolemia, and Cholesterol Medication Use: The Minnesota Heart Survey, 1980–1982 to 2000–2002. Circulation. 2005;112(25):3884-3891.
15. Shay CM, Ning H, Daniels SR, Rooks CR, Gidding SS, Lloyd-Jones DM. Status of cardiovascular health in US adolescents: prevalence estimates from the National Health and Nutrition Examination Surveys (NHANES) 2005-2010. Circulation. 2013;Apr 2;127(13):1369-1376.
16. Ford ES, Mokdad AH, Giles WH, Mensah GA. Serum Total Cholesterol Concentrations and Awareness, Treatment, and Control of Hypercholesterolemia Among US Adults: Findings From the National Health and Nutrition Examination Survey, 1999 to 2000. Circulation. 2003;107(17):2185-2189.
17. Carroll MD KB, Lacher DA, Yoon SS. Total and high-density lipoprotein cholesterol in adults: National Health and Nutrition Examination Survey, 2011-2012. NCHS Data Brief. 2013; Oct.(132):1-8.
18. Kit BK, Kuklina E, Carroll MD, Ostchega Y, Freedman DS, Ogden CL. Prevalence of and trends in dyslipidemia and blood pressure among US children and adolescents, 1999-2012. JAMA Pediatrics. 2015;Mar;169(3):272-279.

19. Lloyd-Jones DM, Hong Y, Labarthe D, Mozaffarian D, Appel LJ, Van Horn L, Greenlund K, Daniels S, Nichol G, Tomaselli GF, Arnett DK, Fonarow GC, Ho PM, Lauer MS, Masoudi FA, Robertson RM, Roger V, Schwamm LH, Sorlie P, Yancy CW, Rosamond WD, Committee AHASPTFaS. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic Impact Goal through 2020 and beyond. Circulation. 2010;Feb 2;121(4):586-613.
20. Ford ES, Li C, Zhao G, Pearson WS, Mokdad AH. Hypertriglyceridemia and its pharmacologic treatment among US adults. Archives of Internal Medicine. 2009;169(6):572-578.
21. Kuklina EV, Yoon PW, Keenan NL. Trends in high levels of low-density lipoprotein cholesterol in the United States, 1999-2006. Journal of the American Medical Association. 2009;Nov 18;302(19):2104-2110.
22. Christian JB, Bourgeois N, Snipes R, Lowe KA. Prevalence of severe (500 to 2,000 mg/dl) hypertriglyceridemia in United States adults. American Journal of Cardiology. 2011;Mar 15;107(6):891-897.
23. Centers for Disease Control and Prevention. Prevalence of abnormal lipid levels among youths --- United States, 1999-2006. Morbidity and Mortality Weekly Report. 2010;Jan 22;59(2):29-33.
24. Earle-Richardson G, Scribani M, Scott E, May J, Jenkins P. A Comparison of Health, Health Behavior, and Access Between Farm and Nonfarm Populations in Rural New York State. The Journal of Rural Health. 2015;31(2):157-164.
25. Centers for Disease Control and Prevention. Vital Statistics, Detailed Tables for the National Vital Statistics Report (NVSR) "Deaths: Final Data for 2013.". Mortality Multiple Cause Micro-data Files 2013; http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_02.pdf.
26. Carroll MD KB, Lacher DA, Shero ST, Mussolino ME. Trends in Lipids and Lipoproteins in US Adults, 1988-2010. Journal of the American Medical Association. 2012;308(15):1545-1554.
27. Mann D, Reynolds K, Smith D, Muntner P. Trends in statin use and low-density lipoprotein cholesterol levels among US adults: impact of the 2001 National Cholesterol Education Program guidelines. Annals of Pharmacotherapy. 2008;Sep;42(9):1208-1215.
28. Gu Q, Paulose-Ram R, Burt VL, Kit BK. Prescription Cholesterol-lowering Medication Use in Adults Aged 40 and Over: United States, 2003–2012. NCHS Data Brief 2014; http://www.cdc.gov/nchs/data/databriefs/db177.htm#ref1.
29. Okere AN, Serra C. Evaluation of the Potential Role of Alirocumab in the Management of Hypercholesterolemia in Patients with High-Risk Cardiovascular Disease. Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy. 2015;35(8):771-779.
30. Wu BU, Pandol SJ, Liu IL. Simvastatin is associated with reduced risk of acute pancreatitis: findings from a regional integrated healthcare system. Gut. 2015;64(1):133-138.
31. Ito MK. Long-chain omega-3 fatty acids, fibrates and niacin as therapeutic options in the treatment of hypertriglyceridemia: A review of the literature. Atherosclerosis. 2015;Oct;242(2):647-656.
32. Capell WH, DeSouza CA, Poirier P, Bell ML, Stauffer BL, Weil KM, Hernandez TL, Eckel RH. Short-term triglyceride lowering with fenofibrate improves vasodilator function in subjects with hypertriglyceridemia. Arteriosclerosis, Thrombosis, and Vascular Biology. 2003;23(2):307-313.
33. Kastelein JJP, Maki KC, Susekov A, Ezhov M, Nordestgaard BG, Machielse BN, Kling D, Davidson MH. Omega-3 free fatty acids for the treatment of severe hypertriglyceridemia: The EpanoVa fOr Lowering Very high triglyceridEs (EVOLVE) trial. Journal of Clinical Lipidology. 2014;8(1):94-106.
34. Dunbar RL, Nicholls SJ, Maki KC, Roth EM, Orloff DG, Curcio D, Johnson J, Kling D, Davidson MH. Effects of omega-3 carboxylic acids on lipoprotein particles and other cardiovascular risk markers in high-risk statin-treated patients with residual hypertriglyceridemia: a randomized, controlled, double-blind trial. Lipids in Health and Disease. 2015;14:98.
35. Zhao A, Lam S. Omega-3-Carboxylic Acid (Epanova) for Hypertriglyceridemia. Cardiology in Review. 2015;23(3).

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