Preventative Cardiology & Lipid Management

18th Annual Doernbecher Pediatric Review

October 25, 2024

Maggie Likes, MD
Associate Professor of Pediatrics, OHSU
Pediatric Cardiology, Doernbecher Children's Hospital

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Goals & Objectives

- Briefly review the history of landmark studies for children
- Outline current lipid guidelines
- Discuss the importance and timing of screening
- Describe management strategies for children

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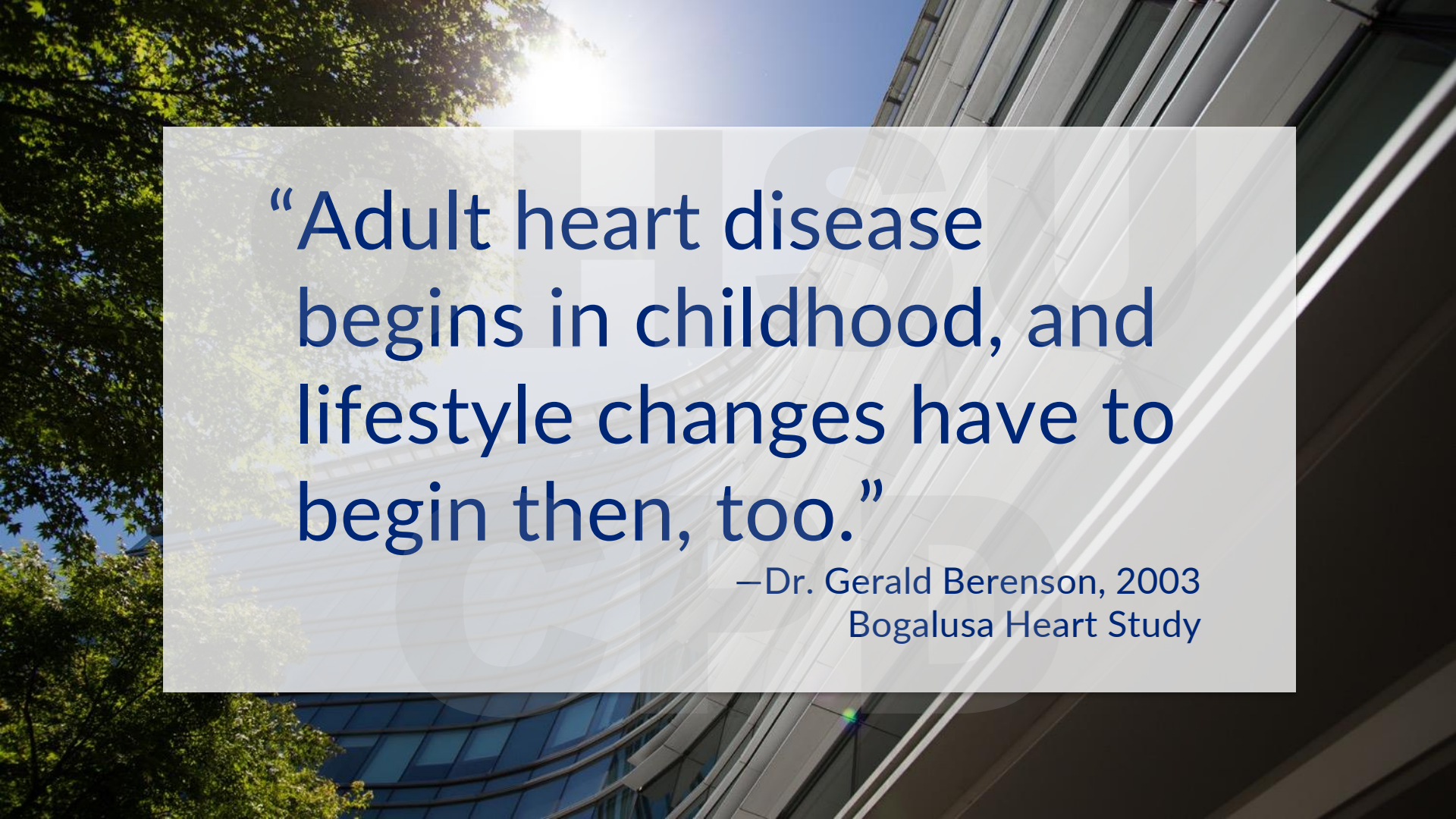
“Adult heart disease begins in childhood, and lifestyle changes have to begin then, too.”
—Dr. Gerald Berenson, 2003
Bogalusa Heart Study

What are Lipids (and why do we care?) Key things to remember

- Fatty compounds that are poorly soluble in blood so they are carried by lipoproteins
- Lipids= Cholesterol, Triglycerides, Phospholipids (cell membrane)
- Combined with proteins → lipoproteins
- **ApoB-lipoproteins → Atherosclerosis**
  - LDL-C, IDL, VLDL, chylomicron remnants
- **ApoA-lipoproteins → Atheroprotective**
  - HDL-C, the “good” cholesterol

History of Pediatric Lipidology

- Bogalusa Heart Study
- Muscatine Study
- Childhood determinants of adult health (CDAH)
- CV risk in young Finns study
- Pathologic Determinants of atherosclerosis in youth

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SCHOOL of MEDICINE

Bogalusa Heart Study

- Founded in 1972 by Dr Gerald Berenson, a Bogalusa, LA native & pediatric cardiologist
- Epidemiologic study from birth through 26 years old, biracial cohort
- Showed that the major etiologies of adult heart disease, atherosclerosis, coronary artery disease, and essential hypertension begins in childhood.
  - Documented anatomic changes occur by 5 to 8 years of age.
- 2003 JAMA: Found childhood LDL-C levels and BMI predicted carotid intima-media thickness (IMT) in young adults. Cohort study of 486 patients age 25-37 who had at least 3 measurements of risk factors since childhood (between 1973-1996)

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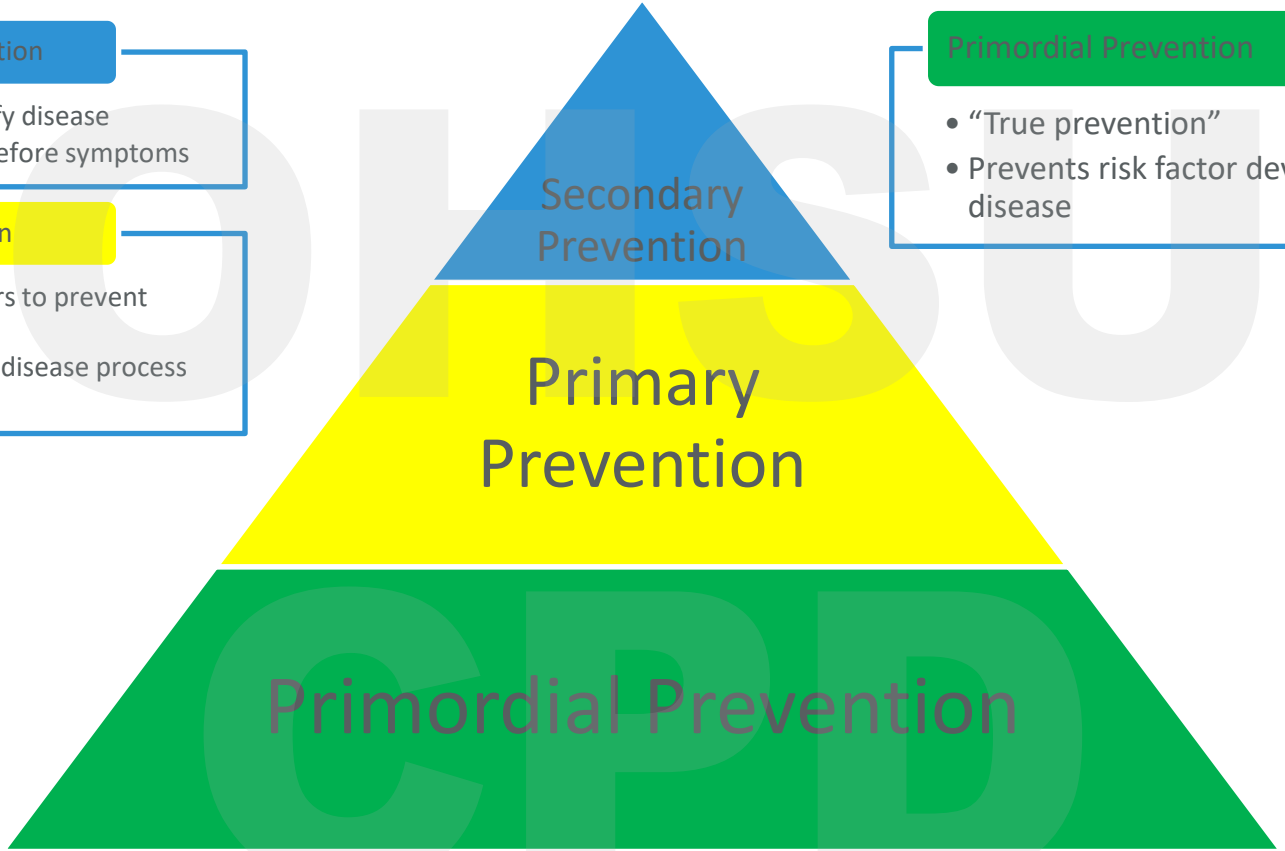
Secondary prevention

- Screens to identify disease
- Early detection before symptoms

Primary prevention

- Modify risk factors to prevent disease
- Intervene before disease process begins



Primordial Prevention

- "True prevention"
- Prevents risk factor development of disease

Pediatric Lipid Guidelines

Circulation

AHA SCIENTIFIC STATEMENT

Cardiovascular Risk Reduction in High-Risk Pediatric Patients

A Scientific Statement From the American Heart Association

TOP 10 TAKE-HOME MESSAGES TO REDUCE RISK OF ATHEROSCLEROTIC CARDIOVASCULAR DISEASE (ASCVD) THROUGH CHOLESTEROL MANAGEMENT

#1 “In all individuals, emphasize a heart-healthy lifestyle across the life course.”

- Reduces ASCVD risk at all ages
- In younger people, healthy lifestyles can reduce development of risk factors and is the **foundation** of ASCVD risk reduction
- In all age groups, lifestyle therapy is the primary intervention for metabolic syndrome

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2018 AHA/ACC Guideline on the Management of Blood Cholesterol. Grundy et al. 2018. *Circulation* 2018

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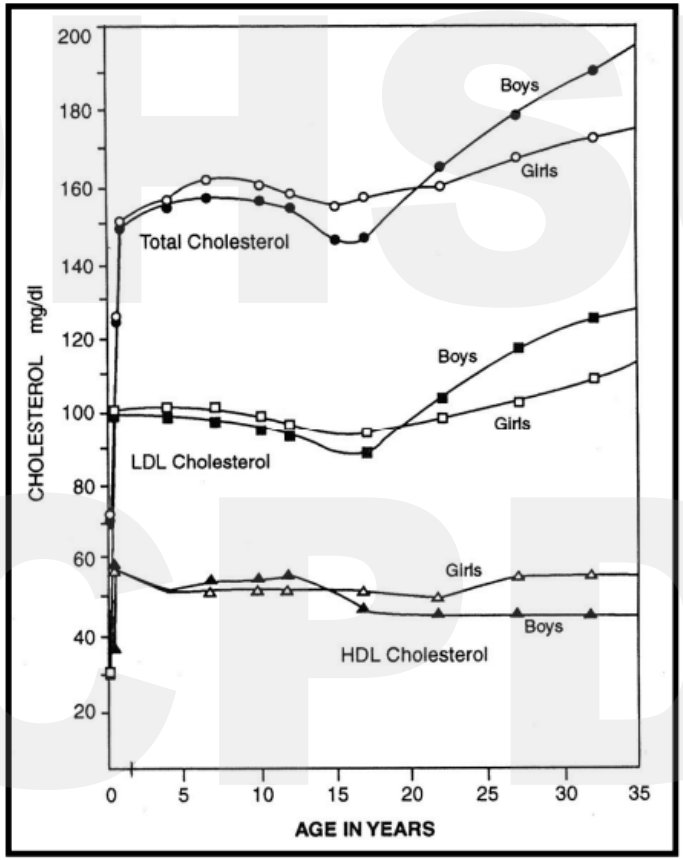
Cholesterol Levels and Age

- Cholesterol is very low at birth
- Cholesterol increases from birth to 2 years old
- Total cholesterol (TC) and LDL-C
  - Plateau between 9-11 years
  - Fall during puberty (10-20% or more)

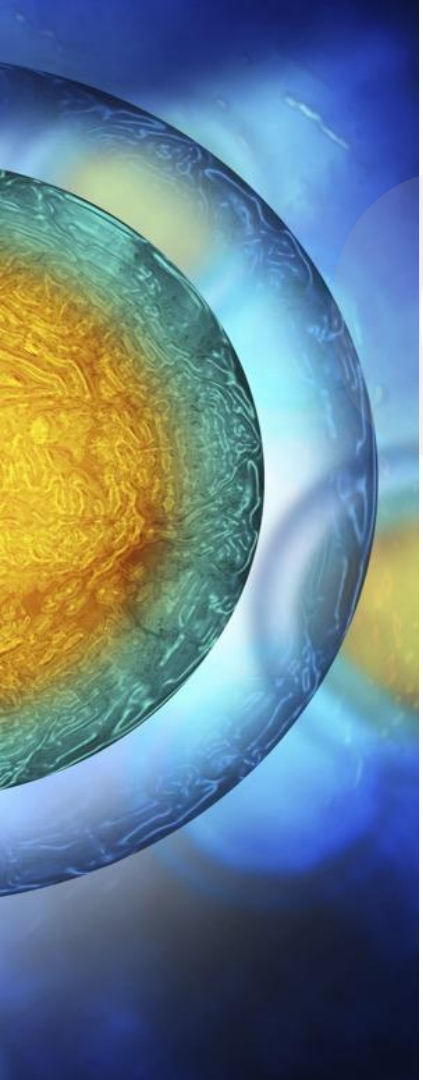
Cholesterol levels over time



Pediatric Lipid Screening McNeal CJ et al. Clinical Lipidology. 2013;8:425-436

Background on screening

- Approx 1 out of 5 adolescents will have abnormal lipid levels
- Occurs frequently with obesity & CV risk factors
- Severe hypercholesterolemia (LDL-C ≥190 mg/dl) occurs in ~1/250 children & adolescents
- Significantly abnormal lipid levels track from childhood to adulthood
- Subclinical atherosclerosis (Carotid IMT) is abnormal in children with FH (Familial Hypercholesterolemia)



Pediatric Lipid Screening over time

- **2011**: AAP Publishes the summary report of the NHLBI expert panel integrated guidelines for cardiovascular risk reduction in children and adolescents
- Universal screening recommended for all children
  - **ages 9-11 years old**
  - again between **ages 18-21 years**
- Obtain a non-fasting “non-HDL” (TC-HDL) or fasting lipid panel

Integrated Cardiovascular Health Schedule 2011

3. INTEGRATED CARDIOVASCULAR HEALTH SCHEDULE

Risk Factor	Age					
	Birth to 12 mo	1–4 y	5–9 y	9–11 y	12–17 y	18–21 y
Family history of early CVD	—	At 3 y, evaluate family history for early CVD: parents, grandparents, aunts/uncles, men ≤55 y old, women ≤65 y old; review with parents and refer as needed; positive family history identifies children for intensive CVD RF attention	Update at each nonurgent health encounter	Reevaluate family history for early CVD in parents, grandparents, aunts/uncles, men ≤55 y old, women ≤65 y old	Update at each nonurgent health encounter	Repeat family-history evaluation with patient
Tobacco exposure	Advise smoke-free home; offer smoking-cessation assistance or referral to parents	Continue active antismoking advice with parents; offer smoking-cessation assistance and referral as needed	Obtain smoke exposure history from child Begin active antismoking advice with child	Assess smoking status of child; active antismoking counseling or referral as needed	Continue active antismoking counseling with patient; offer smoking-cessation assistance or referral as needed	Reinforce strong antismoking message; offer smoking-cessation assistance or referral as needed
Nutrition/diet	Support breastfeeding as optimal to 12 mo of age if possible; add formula if breastfeeding decreases or stops before 12 mo of age	At age 12–24 mo, may change to cow's milk with 2% percentage of fat decided by family and pediatric care provider; after 2 y of age, fat-free milk for all; juice ≤4 oz/d; transition to CHILD-1 diet by the age of 2 y	Reinforce CHILD-1 diet messages	Reinforce CHILD-1 diet messages as needed	Obtain diet information from child and use to reinforce healthy diet and limitations and provide counseling as needed	Review healthy diet with patient
Growth, overweight/ obesity	Review family history for obesity; discuss weight-for-height tracking, growth chart, and healthy diet	Chart height/weight/BMI; classify weight-by BMI from age 2 y; review with parent	Chart height/weight/BMI and review with parent; BMI ≥ 85th percentile, crossing percentiles: Intensify diet/ activity focus for 6 mo; if no change: RD referral, manage	Chart height/weight/BMI and review with parent and child; BMI ≥ 85th percentile, crossing percentiles: Intensify diet/activity focus for 6 mo; if no change: RD referral,	Chart height/weight/BMI and review with child and parent; BMI ≥85th percentile, crossing percentiles: intensify diet/activity focus for 6 mo; if no change: RD referral, manage per obesity algorithms;	Review height/weight/BMI and norms for health with patient; BMI ≥ 85th percentile, crossing percentiles: intensify diet/activity focus for 6 mo; if no change: RD referral, manage per obesity algorithms; BMI ≥ 95th
Lipids	No routine lipid screening	Obtain FLP only if family history for CVD is positive, parent has dyslipidemia, child has any other RFs or high-risk condition	Obtain FLP only if family history for CVD is positive, parent has dyslipidemia, child has any other RFs or high-risk condition	Obtain universal lipid screen with nonfasting non-HDL = TC − HDL, or FLP: manage per lipid algorithms as needed	Obtain FLP if family history newly positive, parent has dyslipidemia, child has any other RFs or high-risk condition; manage per lipid algorithms as needed	Measure 1 nonfasting non–HDL or FLP in all: review with patient; manage with lipid algorithms per ATP as needed
		Renal/urologic/cardiac diagnosis or history of neonatal ICU	the age of 3 y; chart for age/ gender/height percentile and review with parent	age/gender/height: review with parent; workup and/or management per BP algorithm as needed	age/gender/height: review with parent, workup and/or management per BP algorithm as needed	age/gender/height: review with adolescent and parent, workup and/or management per BP algorithm as needed	evaluate and treat per JNC guidelines
Physical activity	Encourage parents to model routine activity; no screen time before the age of 2 y	Encourage active play; limit sedentary/screen time to ≤2 h/d; no TV in bedroom	Recommend MVPA of ≥1 h/d; limit screen/sedentary time to ≤2 h/d	Obtain activity history from child: recommend MVPA of ≥1 h/d and screen/sedentary time of ≤2 h/d	Use activity history with adolescent to reinforce MVPA of ≥1 h/d and leisure screen time of ≤2 h/d	Discuss lifelong activity, sedentary time limits with patient
Diabetes	—	—	—	Measure fasting glucose level per ADA guidelines; refer to endocrinologist as needed	Measure fasting glucose level per ADA guidelines; refer to endocrinologist as needed	Obtain fasting glucose level if indicated; refer to endocrinologist as needed

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Risk Factors & Special Conditions

TABLE 9-6 Risk-Factor Definitions for Dyslipidemia Algorithms

Positive family history: myocardial infarction, angina, coronary artery bypass graft/stent/angioplasty, sudden cardiac death in parent, grandparent, aunt, or uncle at <55 y for males, <65 y for females

High-level RFs
- Hypertension that requires drug therapy (BP ≥ 99th percentile + 5 mm Hg)
- Current cigarette smoker
- BMI at the ≥97th percentile
- Presence of high-risk conditions (Table 9-7)
- (DM is also a high-level RF, but it is classified here as a high-risk condition to correspond with Adult Treatment Panel III recommendations for adults that DM be considered a CVD equivalent.)

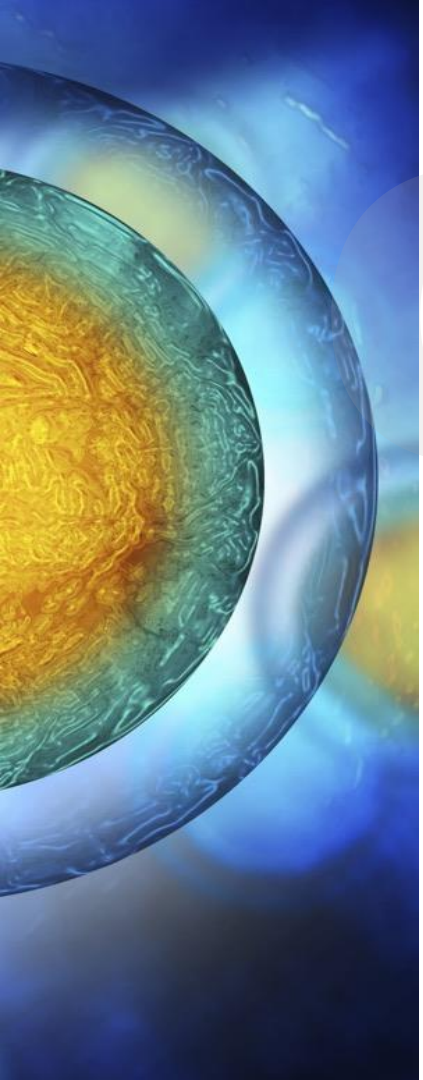
Moderate-level RFs
- Hypertension that does not require drug therapy
- BMI at the ≥95th percentile, <97th percentile
- HDL cholesterol < 40 mg/dL
- Presence of moderate-risk conditions (Table 9-7)

RF indicates risk factor.

TABLE 9-7 Special Risk Conditions

High risk
- T1DM and T2DM
- Chronic kidney disease/end-stage renal disease/post–renal transplant
- Post–orthotopic heart transplant
- Kawasaki disease with current aneurysms

Moderate risk
- Kawasaki disease with regressed coronary aneurysms
- Chronic inflammatory disease (systemic lupus erythematosus, juvenile rheumatoid arthritis)
- HIV infection
- Nephrotic syndrome



Pediatric Lipid Screening over time

- **2018:** AHA/ACC 2018 Cholesterol Clinical Practice Guidelines
  - Focused more on the importance of targeted screening
  - Called out risk factors such as obesity (most prevalent risk factor in children)
  - “may be reasonable” to continue universal screening
- **2019:** AHA statement on CV risk reduction in high risk pediatric patients
  - High risk, moderate risk and “at risk” populations
  - **Yearly screening** with nonfasting non-HDL followed by fasting lipid panel if abnormal

Screening in reality

- Pediatric lipid screening still is not widely used
- More physician/provider education is needed
- More family awareness needed
- Sometimes difficult with family/society beliefs about nutrition and activity levels in kids
- Improving with support from guidelines and AHA/ AAP awareness campaigns

What is considered abnormal?

	Acceptable, mg/dL	Borderline, mg/dL	Abnormal, mg/dL
TC	<170 (<4.3 mmol/L)	170–199 (4.3–5.1 mmol/L)	≥200 (≥5.1 mmol/L)
Triglycerides (0-9 y)	<75 (<0.8 mmol/L)	75–99 (0.8–1.1 mmol/L)	≥100 (≥1.1 mmol/L)
Triglycerides (10-19 y)	<90 (<1.0 mmol/L)	90–129 (1.0–1.5 mmol/L)	≥130 (≥1.4 mmol/L)
HDL-C	>45 (>1.2 mmol/L)	40–45 (1.0–1.2 mmol/L)	<40 (<1.0 mmol/L)
LDL-C	<110 (<2.8 mmol/L)	110–129 (2.8–3.3 mmol/L)	≥130 (≥3.4 mmol/L)
Non–HDL-C	<120 (<3.1 mmol/L)	120–144 (3.1–3.7 mmol/L)	≥145 (≥3.7 mmol/L)

Non-Fasting Lipids

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2018 AHA/ACC Guideline on the Management of Blood Cholesterol. Grundy et al. 2018. *Circulation* 2018

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Familial Hypercholesterolemia (FH)

- Heterozygous FH (HeFH) is a common cause of inherited high LDL
  - Homozygous FH (HoFH) is rare
- Autosomal dominant (common) and recessive (rare)
- Clinically: xanthomas, xanthelasma, corneal arcus, aortic stenosis
- Prevalence approx. **1:200-300** in the general population
- There are clinical criteria for the diagnosis of FH (US, UK, Netherlands)
- Can be confirmed with genetic testing

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FAMILY HEART FOUNDATION
Lipoprotein(a) & Familial Hypercholesterolemia

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Familial Hypercholesterolemia (FH) in Children

- Suspected if a fasting LDL-C ≥ 160 mg/dL
- Over 80% chance of FH if an LDL-C is ≥ 190 mg/dL in a patient under 20 years old
- ½ men and ¼ women with FH have a CV event by 50 years old!

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Reverse Cascade screening

- “In children and adolescents found to have moderate or severe hypercholesterolemia, it is reasonable to carry out reverse-cascade screening of family members, which includes cholesterol testing for first-, second-, and when possible, third-degree biological relatives, for detection of familial forms of hypercholesterolemia.”

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2018 AHA/ACC Guideline on the Management of Blood Cholesterol. Grundy et al. 2018. *Circulation* 2018

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Management of Pediatric Dyslipidemia

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Table 9–3. **CAUSES OF SECONDARY DYSLIPIDEMIA**

Exogenous
Alcohol
Drug therapy:
- Corticosteroids
- Isoretinoin
- Beta-blockers
- Some oral contraceptives
- Select chemotherapeutic agents
- Select antiretroviral agents

Endocrine/Metabolic
Hypothyroidism/hypopituitarism
Diabetes mellitus type 1 and type 2
Pregnancy
Polycystic ovary syndrome
Lipodystrophy
Acute intermittent porphyria

Renal
Chronic renal disease
Hemolytic uremic syndrome
Nephrotic syndrome

Infectious
Acute viral/bacterial infection*
Human immunodeficiency virus (HIV) infection
Hepatitis

Hepatic
Obstructive liver disease/cholestatic conditions
Biliary cirrhosis
Alagille syndrome

Inflammatory
Systemic lupus erythematosis
Juvenile rheumatoid arthritis

Storage
Glycogen storage disease
Gaucher's disease
Cystine storage disease
Juvenile Tay-Sachs disease
Niemann-Pick disease

Other
Kawasaki disease
Anorexia nervosa
Post solid organ transplantation
Childhood cancer survivor
Progeria
Idiopathic hypercalcemia
Klinefelter syndrome
Werner's syndrome

* Delay measurement until ≥3 weeks postinfection.

AHA Scientific Statement 2019
Diet for children with elevated LDL-C

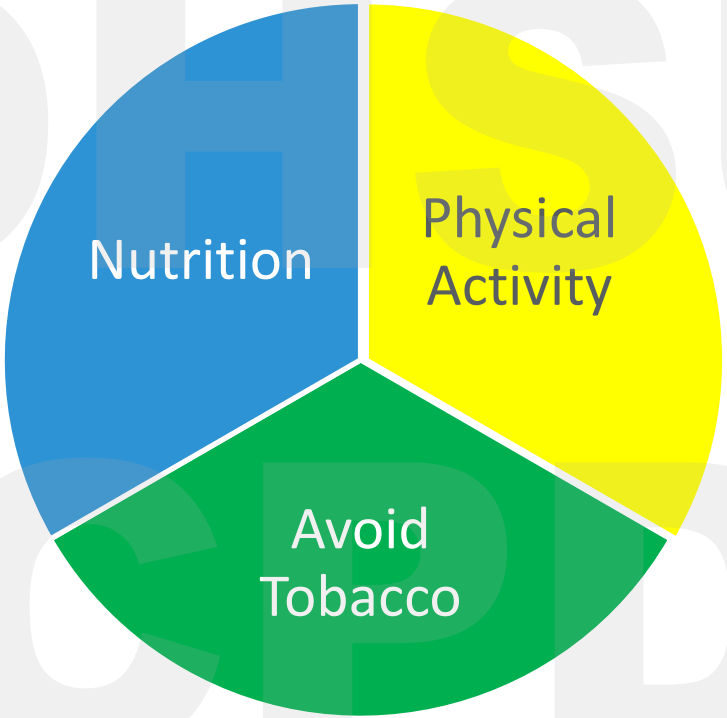
- Low saturated fats, high poly and monounsaturated fats, avoid trans fats
- High in fiber from fruits, vegetables, whole grains
- Consider phytosterol supplements

de Ferranti et al. Circulation. 2019;139:e603–e634

Exercise Recommendations

- There is a “dose-response” effect on lipids.
  - Lowers TC, LDL-C and TGs, raises HDL
- American College of Sports Medicine 2018:
  - Preschool (ages 3-5 years) should be physically active throughout the day and encouraged to play in a variety of activity types
  - Kids ages 6-17 years
    - 60 minutes/day of moderate to vigorous activity (mostly aerobic)- running, biking, swimming
    - 3 x/week muscle strengthening activates- gymnastics, climbing, monkey bars
    - 3 x/week bone strengthening activities- jump rope, tennis, basketball, hopscotch

Primary Prevention for all Children & Adolescents



What's next in management?

- Drug therapy:
  - Children and adolescents 10 years and older with LDL-C persistently ≥ 190 mg/dL or ≥ 160 mg/dL with clinical presentation of FH who do not respond adequately after 3-6 months of lifestyle therapy it is reasonable to start statin therapy
  - Statins may be considered at 8 years old in the presence of concerning family history, extremely elevated LDL-C level, or elevated Lp(a), in the context of informed shared decision-making and counseling with the patient and family.

We recommend selective screening of Lp(a) in high-risk children <18 years of age. This includes children with:

1) clinically suspected or genetically confirmed FH;
2) first-degree relatives with a history of premature ASCVD (age <55 years in men, <65 years in women);
3) ischemic stroke of unknown cause; or
4) first-degree relatives with elevated Lp(a)[1]

Lipoprotein (a)/ Lp(a)

- An “LDL-C like” particle, genetically transmitted
- The LPA gene is fully expressed by 1-2 y of age and the concentration of Lp(a) reaches adult levels by ~5 y of age.
- Well recognized independent risk factor for ASCVD
- Elevated in 20% of the population
- Lifestyle modifications has little effect on levels
- Statin therapy does not decrease levels
- Measurement of Lp(a) in youth with a history of ischemic stroke may be reasonable.

Statins Role in Therapy

- First line after lifestyle modifications for most patients
- Clinically proven to reduce mortality and CV event in adults
- Highly effective at lowering LDL-C in a dose dependent manner in adults & children
- Overall well tolerated with very little reported side effects in children and adolescents

LDL-C lipid medications for high risk populations

Treatment Targets Based on CVD Risk Categories		
High Risk	**Moderate Risk**	**At Risk**
Threshold: LDL-C ≥130 mg/dL	Threshold: LDL-C ≥160 mg/dL	Threshold: LDL-C ≥160 mg/dL
Treatment: Initiate statin and therapeutic lifestyle change simultaneously.	Treatment: Therapeutic lifestyle change for 3 mo; if LDL remains above goal, add statin.	Treatment: Therapeutic lifestyle change for 6 mo; if LDL remains above goal, add statin.
Treatment goal: LDL-C <100 mg/dL	Treatment goal: LDL-C <130 mg/dL	Treatment goal: LDL-C <130 mg/dL

Table 1. Disease Stratification by Risk

Category	Condition
High risk	Homozygous FH, T2DM, end-stage renal disease, T1DM, Kawasaki disease with persistent aneurysms, solid-organ transplant vasculopathy, childhood cancer survivor (stem cell recipient)
Moderate risk	Severe obesity, heterozygous FH, confirmed hypertension, coarctation, Lp(a), predialysis CKD, AS, childhood cancer survivor (chest radiation)
At risk	Obesity, insulin resistance with comorbidities (dyslipidemia, NAFLD, PCOS), white-coat hypertension, HCM and other cardiomyopathies, pulmonary hypertension, chronic inflammatory conditions (JIA, SLE, IBD, HIV), s/p coronary artery translocation for anomalous coronary arteries or transposition of the great arteries, childhood cancer (cardiotoxic chemotherapy only), Kawasaki disease with regressed aneurysms (zMax ≥5)

de Ferranti et al. Circulation. 2019;139:e603–e634

Statins in children

Arteriosclerosis, Thrombosis, and Vascular Biology
Volume 27, Issue 8, 1 August 2007; Pages 1803-1810
https://doi.org/10.1161/ATVBAHA.107.145151

American Heart Association.

ATHEROSCLEROSIS AND LIPOPROTEINS

A Systematic Review and Meta-Analysis of Statin Therapy in Children With Familial Hypercholesterolemia

H.J. Avis, M.N. Vissers, E.A. Stein, F.A. Wijburg, M.D. Trip, J.J.P. Kastelein, and B.A. Hutten

Statins in children

- Meta-analysis of 6 studies: randomized, double-blind, placebo-controlled trials evaluating statin therapy in children aged 8 to 18 years with HeFH.
- TC, LDL-C, & apolipo B were significantly reduced, whereas HDL-C & apolipo A1 were significantly increased by statin therapy.
- No statistically significant differences were found between statin- and placebo-treated children:
  - occurrence of adverse events
  - sexual development
  - Muscle or liver toxicity

Avis et al. Statin Therapy in Children With FH. Arterioscler Thromb Vasc Biol. August 2007

Approved Lipid-Lowering Drug Therapy in Pediatric Patients

Drug	Ages (yr)	Approved Daily Dose
Statins:		
• Atorvastatin	10–17	HeFH: 10 mg starting; 20 mg maximum
• Fluvastatin	10–16	20 mg starting; 80 mg maximum
• Lovastatin	10–17	10 mg starting; 40 mg maximum
• Pravastatin	8–13 14-18	20 mg starting; 20 mg maximum 40 mg starting; 40 mg maximum
• Pitavastatin	8-16	2 mg starting; 4 mg maximum
• Simvastatin	10–17	10 mg starting; 40 mg maximum
• Rosuvastatin	7-17 HoFH 8-17 HeFH	HoFH 20 mg maximum HeFH 8-10 yrs 5-10 mg HeFH 10-17 yrs 5-20mg

Recommendations are from product inserts 2019

LDLc-Lowering Drug Therapy in Pediatric Patients

Drug	Ages (yr)	Approved Daily Dose
Ezetimibe	≥ 10	10 mg starting; 10 mg max
Bile Acid Sequestrants:		
• Colesevelam	10-17	3.75 g (powder preferred)
• Cholestyramine	n/a	240 mg/kg/day with 8 g max
• Colestipol	Safety and effectiveness not been established	
Evolocumab	13-17	HoFH - Normal dose
Niacin	Safety and effectiveness of niacin therapy in pediatric patients (≤16 years) not established	

Recommendations are from product inserts

When should I refer to a Lipid Specialist?

Pediatric Dyslipidemia Clinic

- Suspected or known familial hypercholesterolemia (FH)
- Abnormal cholesterol despite diet and lifestyle modifications x 3-6 months
- TG > 300, LDL > 160, HDL < 35
- Anytime for further guidance and mangement

Key points

- "Adult heart disease begins in childhood, and lifestyle changes have to begin then, too."
  - Primordial prevention is TRUE prevention
- Emphasize a heart-healthy lifestyle across the life course
- Universal lipid screening between 9-11 years (pre puberty) and again between 18-21 years
- Targeted lipid screening starting at age 2 years
- Non fasting non-HDL or a fasting lipid panel can be used as screening
- Don't forget reverse-cascade screening of family members
- Lastly- Statins are first line drugs for children and adolescents with evidence of safety and efficacy

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Thank You

Maggie Likes, MD
likes@ohsu.edu

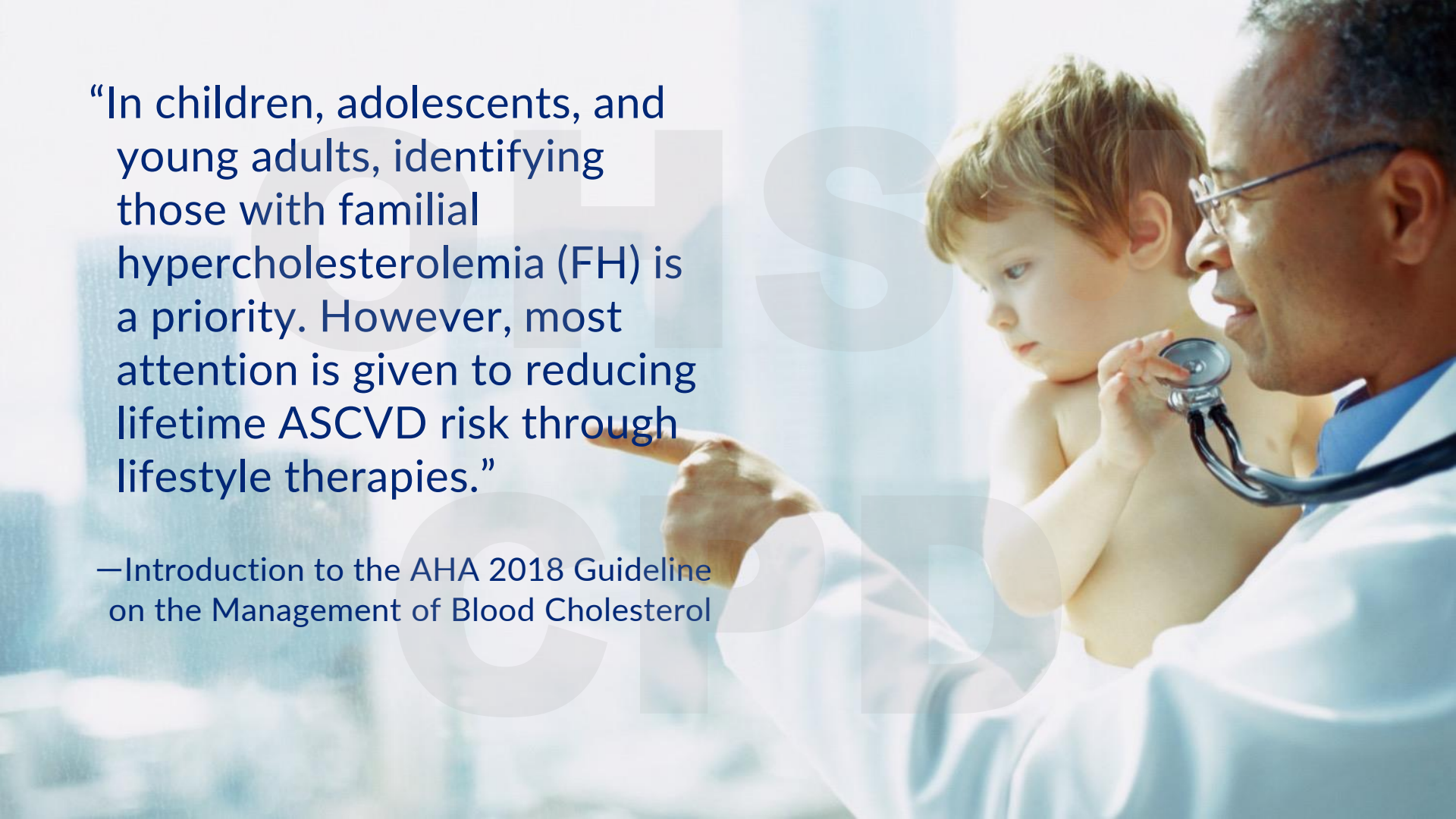
References

1. 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/ AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Grundy et al. 2018 Cholesterol and Clinical Practice Guidelines. *Circulation* 2018
2. Cardiovascular Risk Reduction in High-Risk Pediatric Patients A Scientific Statement From the American Heart Association. de Ferranti et al. *Circulation.* 2019;139:e603–e634

Bonus Slides

"In children, adolescents, and young adults, identifying those with familial hypercholesterolemia (FH) is a priority. However, most attention is given to reducing lifetime ASCVD risk through lifestyle therapies."

—Introduction to the AHA 2018 Guideline on the Management of Blood Cholesterol



2011 NHLBI other risk factors

- Hypertension on treatment
- Obesity
- Tobacco use
- Kidney disease
- HIV
- Diabetes type I and 2
- Heart transplant
- KD with current or regressed coronary aneurysms
- Chronic inflammation- SLE, JIA

2011 NHLBI Family History Risk Factors

- Which relatives count?
  - "Close" relatives such as parents, grandparents, aunts & uncles, *siblings*
- What is early CV events?
  - Women <65 years, Men <55 years
- What CV events?
  - MI, CABG/stent/angioplasty, sudden cardiac deaths
- What dyslipidemia?
  - TC>240 mg/dl or a known dyslipidemia

TABLE 9-1 Acceptable, Borderline-High, and High Plasma Lipid, Lipoprotein, and Apolipoprotein Concentrations for Children and Adolescents

Category	Low, mg/dL[a]	Acceptable, mg/dL	Borderline-High, mg/dL	High, mg/dL[a]
TC	—	<170	170–199	≥200
LDL cholesterol	—	<110	110–129	≥130
Non-HDL cholesterol	—	<120	120–144	≥145
Apolipoprotein B	—	<90	90–109	≥110
Triglycerides				
0–9 y	—	<75	75–99	≥100
10–19 y	—	<90	90–129	≥130
HDL cholesterol	<40	>45	40–45	—
Apolipoprotein A-1	<115	>120	115–120	—

Not for universal screening

2011 NHLBI Expert Panel. Pediatrics

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Evidence for lifestyle modifications

Circulation
Volume 108, Issue 6, 12 August 2003; Pages 672-677
https://doi.org/10.1161/01.CIR.0000083723.75065.D4

CLINICAL INVESTIGATION AND REPORTS

Effect of 7-Year Infancy-Onset Dietary Intervention on Serum Lipoproteins and Lipoprotein Subclasses in Healthy Children in the Prospective, Randomized Special Turku Coronary Risk Factor Intervention Project for Children (STRIP) Study

Tuuli Kaitosaari, MD, Tapani Rönnemaa, MD, PhD, Olli Raitakari, MD, PhD, Sanna Talvia, MSc, Katariina Kallio, MD, Iina Volanen, MD, Aila Leino, PhD, Eero Jokinen, MD, PhD, Ilkka Välimäki, MD, MSc, Jorma Viikari, MD, PhD, and Olli Simell, MD, PhD

Evidence for lifestyle modifications

Long-Term Safety and Efficacy of a Cholesterol-Lowering Diet in Children With Elevated Low-Density Lipoprotein Cholesterol: Seven-Year Results of the Dietary Intervention Study in Children (DISC)

Eva Obarzanek, PhD, RD, MPH*; Sue Y. S. Kimm, MD, MPH‡; Bruce A. Barton, PhD§; Linda Van Horn, PhD, RD‖; Peter O. Kwiterovich, Jr, MD¶; Denise G. Simons-Morton, MD, PhD*; Sally A. Hunsberger, PhD*; Norman L. Lasser, MD, PhD#; Alan M. Robson, MD**; Frank A. Franklin, Jr, MD, PhD‡‡; Ronald M. Lauer, MD§§; Victor J. Stevens, PhD‖‖; Lisa Aronson Friedman, ScM§; Joanne F. Dorgan, PhD, MPH¶¶; and Merwyn R. Greenlick, PhD##, on Behalf of the DISC Collaborative Research Group

PEDIATRICS Vol. 107 No. 2 February 2001

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AHA Scientific Statement 2019
Diet for children with elevated TGs

- High in fiber from fruits, vegetables, whole grains
- Moderate complex carbohydrates
- Low simple carbohydrates and low added sugars
- High poly and mono unsaturated fats

de Ferranti et al. Circulation. 2019;139:e603–e634

More on Statin safety in children

Statins for children with familial hypercholesterolemia (Review)

Vuorio A, Kuoppala J, Kovanen PT, Humphries SE, Tonstad S, Wiegman A, Drogari E, Ramaswami U

Citation: Vuorio A, Kuoppala J, Kovanen PT, Humphries SE, Tonstad S, Wiegman A, Drogari E, Ramaswami U. Statins for children with familial hypercholesterolemia. *Cochrane Database of Systematic Reviews* 2017, Issue 7. Art. No.: CD006401. DOI: 10.1002/14651858.CD006401.pub4.

Cochrane database review 2017

- Concern comes from cholesterol being an important precursor of adrenal and gonadal steroids.
- Statins came with warnings to start after menarche
- Cochrane review of 9 randomized placebo controlled studies (1177 pediatric patients)
  - No sig difference in statin and placebo including delayed sexual maturation
  - 10 year follow-up with no major report events
- Still need to caution with pregnancy as they are thought to be teratogenic

Lipid lowering drug therapy in children and adolescents

- Statins and non-statins lower TC and LDL-C in children with FH and other health conditions that put them at risk of CVD
- Low short and medium term adverse event rates (abnormal LFTs, CKs, reported myopathy)
- Data shows benefit from statins to subclinical atherosclerosis.
- Intensity of treatment should be based on severity of hypercholesterolemia
- Ezetimibe use in children with severe hypercholesterolemia show reasonable LDL-C lowering with no significant adverse effects
- Nonsystemic bile acid sequestrants can be useful for LDL-C lowering, but tolerability is an issue

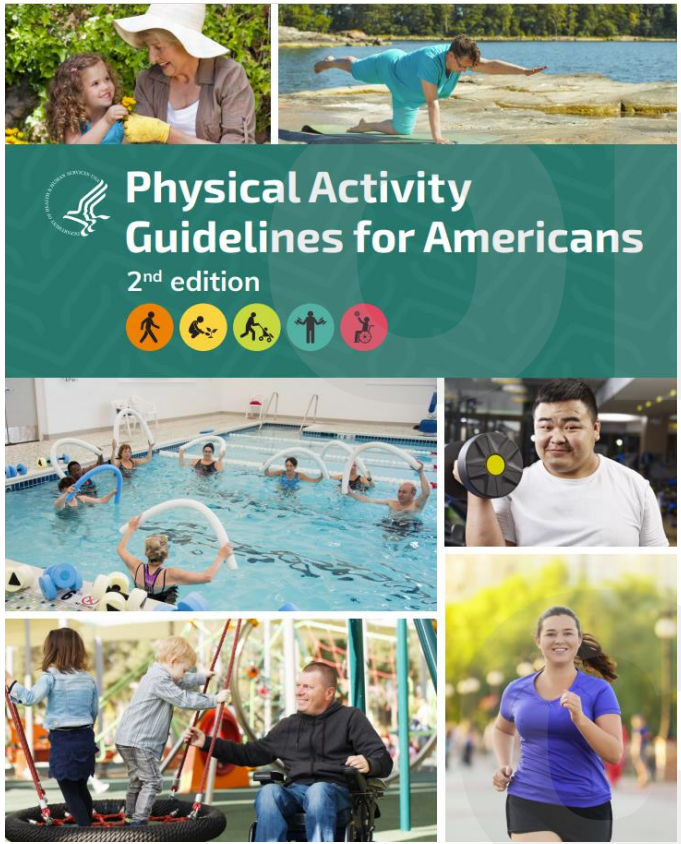
What about triglycerides?

- Triglyceride lowering medications in pediatrics do not have safety or effectiveness established
  - Fibric Acid derivatives, Omega-3 fatty acids, Niacin
  - Not FDA approved in children
- AHA 2019 statement
  - Determine risk→ consider treatment

Elevated Triglycerides

- Screen for lipid disorders with fasting or non-fasting non HDL
  - Fasting if TG is abnormal
- Therapeutic lifestyle changes
- Treatment based on severity
  - Moderate: TG 130-400 mg/dL
  - Significant: TG >400-999 mg/dL
  - Severe TG >1,000 mg/dL

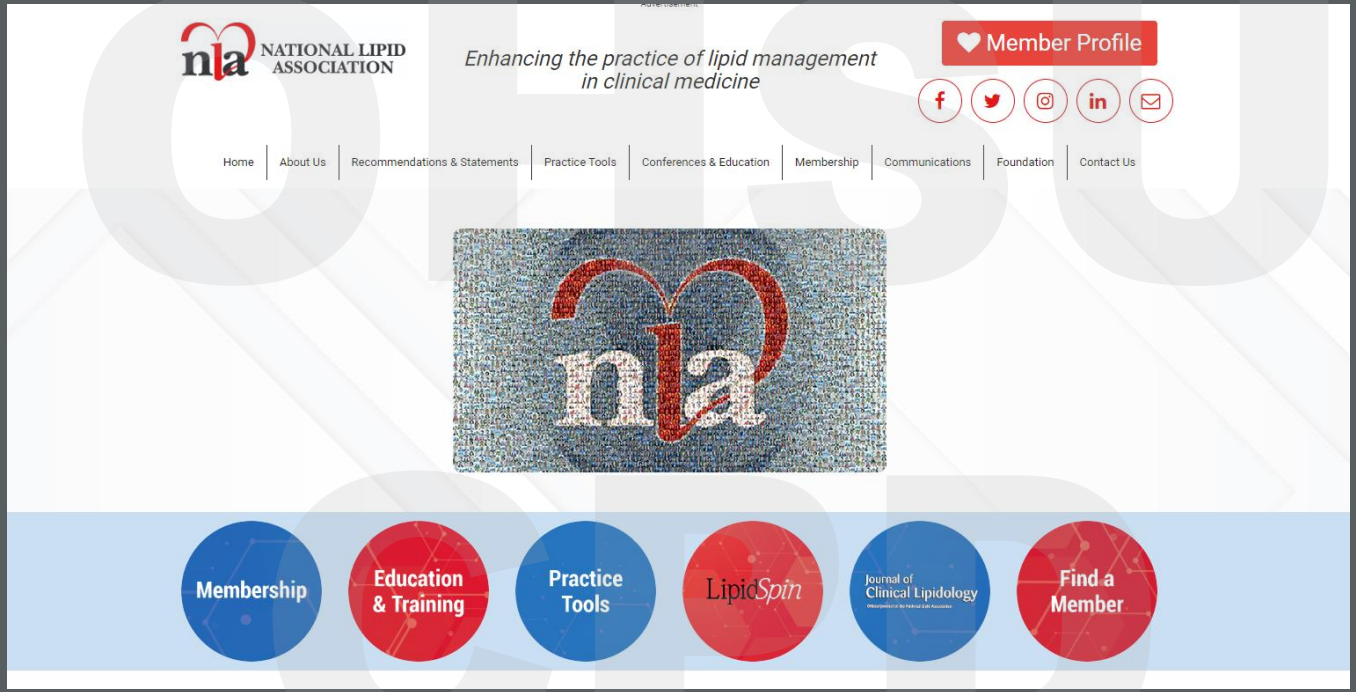
de Ferranti et al. Circulation. 2019;139:e603–e634



Adults

- Gain most health benefits:
  - 150 minutes- 300 minutes a week of moderate-intensity
  - 75 minutes- 150 minutes a week of vigorous-intensity aerobic physical activity
  - or an equivalent combination of moderate- and vigorous-intensity aerobic
- Additional health benefits are gained by engaging in physical activity beyond 300 minutes of moderate-intensity physical activity a week.
- Should also do muscle-strengthening activities that involve all major muscle groups on 2 or more days a week

In case you want to lean more…



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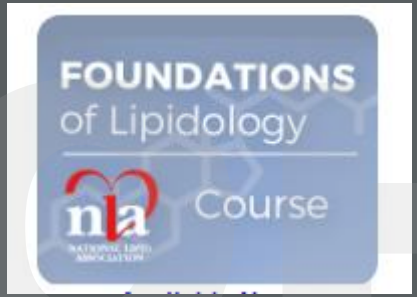

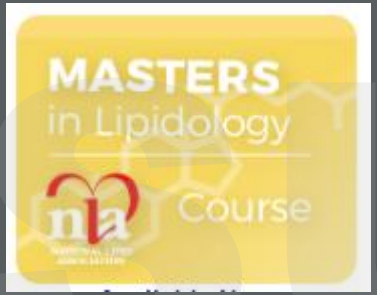

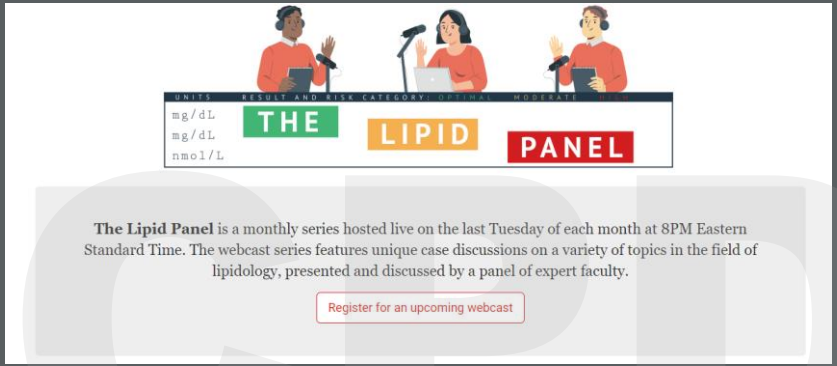

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