Hypertension and Dyslipidemia: Grown up problems in the pediatric population

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Objectives

Following this talk, the learner should:

• Know (or be able to find) pediatric screening recommendations for hypertension and dyslipidemia

• Be able to identify at risk pediatric patients for hypertension and dyslipidemia

• Understand treatment and subspecialty referral options
Disclosures

• I have no financial disclosures

• I will be discussing off-label use of medications
Obesity Trends* Among U.S. Adults, BRFSS 1990
(*BMI \geq 30, or \sim 30\ lbs. overweight for 5’\ 4”\ person)

![Map of Obesity Trends](attachment:image.png)
Obesity Trends* Among U.S. Adults, BRFSS 1991

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 1992

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 1993
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 1994

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 1995

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 1996
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 1997

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(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 2001

(*BMI ≥ 30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 2002
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 2003
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 2004

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 2005

(*BMI ≥ 30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 2006
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 2007

(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4” person)
Obesity Trends* Among U.S. Adults, BRFSS 2008

(*BMI ≥30, or ~ 30 lbs. overweight for 5’4” person)
Pediatric Hypertension and Dyslipidemia

Hypertension

Metabolic Syndrome

Dyslipidemia
"You’ve got the blood pressure of a teenager – who lives on junk food, TV and the computer."

Pediatrics 2004;114:555

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://pediatrics.aappublications.org/content/114/Supplement_2/555.full.html
Hypertension - Screening

- Check BP for any child \( \geq 3 \) years old
- Check BP for any child \(< 3\) years old with the following conditions:
  - History of prematurity, VLBW, NICU stay
  - Congenital heart disease (repaired or nonrepaired)
  - Know renal disease or urological malformation
  - Recurrent UTI’s, hematuria, proteinuria
  - Family history of congenital renal disease
  - Solid organ transplant
  - Malignancy or BMT
  - Treatment with medications known to increase BP
  - Systemic illness known to be associated with increased BP (NFM, TS)
  - Elevated ICP
Hypertension - Screening

• Check BP for any child ≥3 years old
• Check BP for any child <3 years old with the following conditions:
  ▪ History of prematurity, VLBW, NICU stay
  ▪ Congenital heart disease (repaired or nonrepaired)
  ▪ Known or new disease or etiological marker
  ▪ Current UTI’s, hematuria, proteinuria
  ▪ Presence of congenital renal disease
  ▪ History of transplants
  ▪ Renal insufficiency or BUN
  ▪ Treatment with medications known to increase BP
  ▪ Systemic illness known to be associated with increased BP (NFM, TS)
  ▪ Elevated ICP
HEART PROBLEMS  HEME/ONC
EARLY (PREMATURITY)
ALL
RENAL PROBLEMS (INCLUDING FAMILY Hx)
TRANSPLANT
SYSTEMIC DISEASES (Tuberous Sclerosis, NFM)
Hypertension - Measurement

• Sitting

• Appropriate sized cuff

• Feet flat on the floor (never crossed)

• Back and right arm supported; no sleeves

• Cubital fossa at heart level

• Sitting quietly for 5 minutes
Hypertension - Measurement
Hypertension - Measurement

- Sitting
- Appropriate sized cuff
- Feet flat on the floor (never crossed)
- Back and right arm supported; no sleeves
- Cubital fossa at heart level
- Sitting quietly for 5 minutes
Hypertension - Diagnosis

• **<90%ile** for age, gender, and height is normal

• **90-95%ile** is prehypertension → repeat in office x2 and recheck in 6 months

• **95%ile - 99%ile + 5mmHg** is Stage 1 HTN → repeat in office x2 and on at least 2 more occasions
  - Final BP is the average of BP’s taken over weeks to months

• **> 99%ile + 5mmHg** is Stage 2 HTN → repeat in office x2 and refer
Hypertension - Diagnosis

• Symptoms - headache, vomiting, visual changes, chest pain, palpitations, SOB, confusion, seizure

• Adolescents (12yo and up): Any SBP over 120/80mmHg is at least prehypertension

• Consider ambulatory BP monitoring if concerned for “white coat hypertension”
Stage 1 HTN in this 6 yo female is: 113 (95%ile) – 125 (99%ile+5)
Hypertension – Pay Attention

• 14,187 children/adolescents were seen

• 507 (3.6%) had HTN

• Only 131 of these (26%) were dx with HTN or had evidence of BP recognition in the chart

• Only 11% of patients with PreHTN had diagnosis or documentation

Underdiagnosis of hypertension in children and adolescents.
Hypertension – Pay Attention

Prevalence

- Normotensive
- Hypertensive
Hypertension – Pay Attention

RECOGNITION

Unrecognized  Recognized
Fig 1. Management algorithm. Rx indicates prescription; Q, every. *, See Tables 3, 4, and 5; †, diet modification and physical activity; ‡, especially if younger, very high BP, little or no family history, diabetic, or other risk factors.
Hypertension – Work Up

• Any child with at least Stage 1 HTN
  - Hx, PE, 4 extremity BP, Family Hx
  - Chem 10, CBC
  - Fasting Lipid Panel, Fasting Glucose
  - UA, Urine Cx
  - Renal US, Echocardiogram
  - Retinal Exam

• Consider
  - Drug screen
  - Polysomnography
  - Plasma Renin
  - Further Renovascular Imaging
Hypertension – Work Up

142/97  139/95

109/71  113/73

Pediatrics
Hypertension - Treatment

• Weight reduction for obesity-related HTN
  - Dietary modification (fruit/veg, low salt, DASH)
  - Physical activity
  - Family-based intervention
  - Give them a written prescription for exercise
  - Celebrate small successes
Hypertension - Treatment

The graph shows the comparison between the control group and two treatment groups (Fruit/Veg and DASH) over 7 weeks. The graph indicates a 6mmHg reduction in systolic blood pressure for the DASH treatment group compared to the control group.
Hypertension - Treatment

• Indications for pharmacologic treatment
  - Symptomatic HTN
  - Secondary HTN
  - Hypertensive end-organ damage
  - Diabetes other risk factors – lower treatment thresholds and stricter treatment goals
  - Persistent HTN despite nonpharmacologic measures
Hypertension - Treatment

• Medications
  - ACEi – Captopril, Enalapril, Lisinopril
  - Beta Blockers – Propranolol, Atenolol, Metoprolol
  - ARBs – Losartan
  - CCB – Amlodipine
  - Diuretics – HCTZ, Furosemide
HTN – When to Refer?

• Prehypertension – weight and lifestyle modification

• Referral should be considered when the diagnosis of HTN is made
  - Average of at least 3 separate measurements meet Stage 1 criteria (95-99\%ile+5mmHg)
  - If patient meets Stage 2 criteria – more than the 99\%ile+5mmHg, prompt referral (no need to repeat)
  - If patient is symptomatic with very high BP, immediate referral
Atherosclerosis begins at an early age and is accelerated in obese children (fatty streaks).

- Endothelial dysfunction
- Arterial distensibility is decreased
- Obese male children have an increased incidence of MI as adults.
Fatty Streaks
Fatty Steaks

Lipid-containing foam cells just below the endothelium
Atherosclerosis

- Atherosclerosis begins at an early age and is accelerated in obese children (fatty streaks)
- Endothelial dysfunction
- Arterial distensibility is decreased
Definition

Body mass index-for-age percentiles:
Boys, 2 to 20 years

BMI = Weight / (Height/100)^2

≥95th percentile
Obese

85-95th percentile
Overweight
Metabolic Syndrome

• Age 10 – 15 years
  - Obesity >90%ile assessed by waist circumference +2:
    • TG ≥ 150 mg/dL
    • HDL ≤ 40 mg/dL
    • BP ≥ 130 mmHg systolic or ≥ 85 mmHg diastolic
    • Failed OGTT or known type 2 DM

• ≥ 16 years: Use adult criteria
Metabolic Syndrome

• Present in 50% of severely obese children, absent in normal and overweight children

• Highest prevalence is in Mexican-Americans

• Children with Metabolic Syndrome are 14.6 times more likely to have cardiovascular disease in adulthood
Adult Outcomes of Pediatric Obesity

• Obesity in childhood is significantly related to risk of MI in adulthood

• The older the obese child, the higher the risk

• Because of pediatric obesity, estimated 5-16% increase in coronary heart disease in the next 20 years
Adult Disease Starts Early!

BMI in Adolescence (17 year olds)

BMI in Adulthood (30 year olds)
Dyslipidemia

EXPERT PANEL ON INTEGRATED GUIDELINES FOR CARDIOVASCULAR HEALTH AND RISK REDUCTION IN CHILDREN AND ADOLESCENTS

Pediatrics 2011;128;S213; originally published online November 14, 2011;
DOI: 10.1542/peds.2009-2107C
Dyslipidemia - Screening

• 2-8 yo if:
  • Pt with DM, HTN, BMI ≥ 95%ile or smoker
  • Pt with mod or high risk condition
  • if 1° or 2° relative with:
    • MI, angina, stroke, CABG/stent/angioplasty at <55 in M, <65 in F
    • Parent with TC ≥ 240 or (+) dyslipidemia
Dyslipidemia – 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
Dyslipidemia - Screening

• **9-11 yo** – Universal Screening
  • Nonfasting – Calculate NonHDL
    (total – HDL = NonHDL)
  • If NonHDL ≥145 or HDL < 40, repeat and avg results
• Fasting – analyze lipoprotein subtypes
  • Repeat if abnormal and avg results
Dyslipidemia - Screening

• 12-16 yo if:
  • Pt with DM, HTN, BMI ≥85%ile or smoker
  • Pt with mod or high risk condition
  • if 1° or some 2° relative with:
    • MI, angina, stroke, CABG/stent/angioplasty at <55 in M, <65 in F
    • Parent with TC ≥ 240 or (+) dyslipidemia
Dyslipidemia - Screening

• **17-21 yo** – Universal Screening
  • Fasting or NonFasting
  • Threshold values are a bit diff from 9-11yo
  • Even different between 17-19 and 20-21 yo.
**Dyslipidemia algorithm:** target LDL cholesterol. Values given are in mg/dL. To convert to SI units, divide results for TC, LDL cholesterol, HDL cholesterol, and non-HDL cholesterol by 38.6; for triglycerides, divide by 88.6. TG indicates triglycerides; C, cholesterol; RF, risk factor; FHX, family history; a Obtain FLPs at least 2 weeks but no more than 3 months apart. b Per Table 9-8, use of drug therapy is limited to children aged 10 years and older with defined risk profiles. c In a child with an LDL cholesterol level of >190 mg/dL and other risk factors, a trial of the CHILD-2—LDL may be abbreviated.
**Dyslipidemia algorithm:** target triglycerides. Values given are in mg/dL. To convert to SI units, divide results for TC, LDL cholesterol, HDL cholesterol, and non-HDL cholesterol by 38.6; for triglycerides, divide by 88.6. C indicates cholesterol.  

**FLP x 2, average results**  

**TG > 500 mg/dL, Consult lipid specialist**

**LDL-C ≥ 130, < 250 mg/dL**  

→ Target LDL-C  

(see LDL algorithm, Fig 9-1)

**TG ≥ 100, < 500 mg/dL, < 10 y**

≥ 130, < 500 mg/dL, 10–19 y

→ Target TG

**TARGET TGs → CHILD-1 → CHILD-2→TG diet (Table 9-8) + lifestyle modification with WT-loss goal as needed × 6 mo**

**FLP**

**TG < 100 mg/dL <10 y,**

< 130 mg/dL, 10–19 y

→ Continue CHILD-2→TG + lifestyle change

→ Reassess q 12 mo

**TG ≥ 100, < 200 mg/dL, <10 y**

≥ 130, < 200 mg/dL, 10–19y

→ Intensify CHILD-2→TG + WT loss

→ Increase dietary fish content

→ Repeat FLP in 6 mo

**TG ≥ 200–499 mg/dL**

→ If LDL-C target achieved and non-HDL ≥ 145 mg/dL, lipid specialist for drug therapy (statin+fibrate+nicoic acid)

→ Consider ω-3 fish oil therapy

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**FIGURE 9-2**

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# Dyslipidemia

**1st Line:** Diet, Exercise, Lifestyle Modification

## CHILD-1 diet

- Fruits/Veggies
- Beans/Nuts
- Fish
- Water
- Fiber
- Fat Free Milk
- Portion Control
- Physical Activity

- Sweetened Drinks
- Trans fats
- Salt
- Cholesterol
- Red Meat

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*Lipid Screening and Cardiovascular Health in Childhood*

Stephen R. Daniels and Frank R. Greer

*Pediatrics* 2008;122:198

DOI: 10.1542/peds.2008-1349

*Texas Children’s Hospital*

*Baylor College of Medicine*
Dyslipidemia

1st Line: Diet, Exercise, Lifestyle Modification

CHILD-2 diet

- Registered Dietician
- LDL
  - Plant sterol/stanol esters
  - Psyllium fiber
- TG
  - Complex carbs
  - Increase fish and omega-3
Dyslipidemia – When to refer?

• Consider referral if, after strong counseling regarding diet and exercise:
  - LDL > 160 mg/dL on two occasions
  - TG > 150 mg/dL on two occasions
  - HDL < 30 mg/dL on two occasions

<table>
<thead>
<tr>
<th>TABLE 5</th>
<th>Recommended LDL Concentrations for Pharmacologic Treatment of Children and Adolescents 10 Years and Older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Characteristics</td>
<td>Recommended Cut Points</td>
</tr>
<tr>
<td>No other risk factors for CVD</td>
<td>LDL concentration is persistently &gt; 190 mg/dL despite diet therapy</td>
</tr>
<tr>
<td>Other risk factors present, including obesity, hypertension, or cigarette smoking or positive family history of premature CVD</td>
<td>LDL concentration is persistently &gt; 160 mg/dL despite diet therapy</td>
</tr>
<tr>
<td>Children with diabetes mellitus</td>
<td>Pharmacologic treatment should be considered when LDL concentration is ≥130 mg/dL</td>
</tr>
</tbody>
</table>
# TABLE 6

Classes of Medication for Treatment of Dyslipidemia in Children and Adolescents

<table>
<thead>
<tr>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bile acid sequestrant</td>
</tr>
<tr>
<td><em>Cholestyramine</em> (<em>Questran</em>)</td>
</tr>
<tr>
<td>Cholesterol-absorption blocker</td>
</tr>
<tr>
<td><em>Ezetimibe</em> (<em>Zetia</em>)</td>
</tr>
<tr>
<td>3-Hydroxy-3-methyl-glutaryl</td>
</tr>
<tr>
<td>coenzyme A reductase inhibitors</td>
</tr>
<tr>
<td><em>Statins</em></td>
</tr>
</tbody>
</table>
DON'T WORRY ABOUT YOUR CONDITION, GARFIELD

YOU CAN STILL LEAD A USEFUL AND PRODUCTIVE LIFE

AS A PAPERWEIGHT, A DOORSTOP, A...

PUT YOUR FACE CLOSER TO THESE CLAWS

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Not **All** Bad News

**Obesity Research Cluster**
Established 2013

**The New York Times**

**Obesity in Young Is Seen as Falling in Several Cities**

December 12, 2012

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**Texas Children’s Hospital**

Program for Healthy Bodies

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**Play60**

The NFL Movement for an Active Generation

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**Pediatrics**
Thank You