

HYPERLIPIDEMIA

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Hyperlipidemia refers to elevated levels of lipids and cholesterol in the blood, and is also identified as dyslipidemia, to describe the manifestations of different disorders of lipoprotein metabolism. Although elevated low density lipoprotein cholesterol (LDL) is thought to be the best indicator of atherosclerosis risk,¹ dyslipidemia can also describe elevated total cholesterol (TC) or triglycerides (TG), or low levels of high density lipoprotein cholesterol (HDL).

Decisions about treatment of elevated lipids currently focus on the LDL cholesterol level as well as the cardiovascular risk status of the individual. In 1991, the National Cholesterol Education Program (NCEP) of the National Heart Blood and Lung Institute (NHLBI) proposed criteria for “acceptable,” “borderline,” and “high” levels of LDL and TC in children and adolescents² (see Table 1). These criteria have been adopted as the basis for policy statements and treatment guidelines by many organizations, including the American Academy of Pediatrics (AAP),³ the American Heart Association (AHA),⁴ and the American Medical Association’s (AMA) Guidelines for Adolescent Preventive Services.⁵

TABLE 1
Classification of LDL and Total Cholesterol Levels in Adolescents*

	ACCEPTABLE	BORDERLINE	HIGH
Total Cholesterol (mg/dl)	<170 mg/dl	170 – 199 mg/dl	≥ 200 mg/dl
LDL Cholesterol (mg/dl)	<110 mg/dl	110 – 129 mg/dl	≥ 130 mg/dl

*Based on the average of 2 measurements

Source: National Cholesterol Education Program (US). Expert Panel on Blood Cholesterol Levels in Children and Adolescents. National Cholesterol Education Program (US). Report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents. NIH publication no. 91-2732. Bethesda, MD: National Institutes of Health, National Heart Lung and Blood Institute, National Cholesterol Education Program; 1991. Cholesterol in Childhood (RE9805) Policy Statement. American Academy of Pediatrics 1998; 101(1):141-147. <http://www.aap.org/policy/re9805.html>

SIGNIFICANCE

In adults, LDL is strongly associated with a higher risk, and HDL is associated with a lower risk, of coronary heart disease (CHD). Lowering lipids through dietary or pharmacological therapy has been shown to decrease the incidence of atherosclerotic events. Since lipid levels have been observed to track into adulthood, adolescents with hyperlipidemia are also at greater CHD risk. The extent of abnormal lipids and other cardiovascular risk factors during childhood and adolescence is related to the severity of atherosclerosis seen in autopsies of young adults.⁶

Adolescents with “high” TC or LDL may have a genetic disorder of lipid metabolism such as familial hypercholesterolemia or familial combined hypercholesterolemia. Those with homozygous forms of

these disorders can experience myocardial infarction or other events during childhood or early adolescence. Familial hypercholesterolemia is often diagnosed in adolescence and is characterized by high LDL levels that can be refractory to dietary treatment. These patients can present clinically with xanthomas or xanthelasma— cholesterol deposits under the skin on the hands, elbows, knees, heel or eyelids.

Other Risk Factors for CHD

In addition to elevated LDL levels, major risk factors associated with a higher risk of CHD include:^{2,7}

- Family history of premature death in first-degree relative (male relative <55 years, female relative <65 years)
- Hypertension (blood pressure \geq 140/90 mm Hg or on antihypertensive medication)
- Diabetes mellitus (or impaired glucose tolerance)
- Cigarette smoking
- Low HDL cholesterol (<35 mg/dl)
- Overweight or obesity
- Physical inactivity

In the NCEP Adult Treatment Panel III Guidelines for Adults (ATP III),⁸ NCEP redefined low HDL for adults as <40 mg/dl and considers high levels (>60 mg/dl) as protective. Similar adjustments of values for adolescents have not been set, however. Recent research is elucidating the roles of other variables or “emerging risk factors” that are considered to confer greater risk of CHD:

- Increased fibrinogen PA1-1 levels
- Elevated levels of homocysteine
- Increased levels of c-reactive protein
- Increased Lp(a) level
- Role of risk factor reduction in CHD incidence reduction

ASSESSMENT

Rule Out Secondary Causes of Hyperlipidemia

There are subgroups of adolescents at higher risk of hyperlipidemia. Early recognition of secondary dyslipidemia (see Table 2) allows more aggressive intervention and potential amelioration of CHD risk. As in adults, dyslipidemia is common in adolescents with diabetes, typically with elevated LDL and TG, and low HDL. In children and adolescents with type 1 diabetes, good glucose control and physical activity are associated with lower TC.⁷ The prevalence of type 2 diabetes in adolescents is increasing and is associated with obesity, low physical activity, and high dietary fat intakes.⁹

TABLE 2
Secondary Causes of Hyperlipidemia

	Lipid Abnormality		
Anabolic steroid use	↑ LDL		↓ HDL
Anorexia nervosa	↑ LDL		
Cigarette smoking			↓ HDL
Diabetes	↑ LDL	↑ TG	↓ HDL
Glycogen storage diseases			
Hypothyroidism		↑ TG	
Liver disease, obstructive	↑ LDL		
Medications: corticosteroids, bile acid-binding resins, anticonvulsants, certain oral contraceptives, Accutane® (isotretinoin), Depo-provera®	Varies		
Overweight or obesity	↑ LDL	↑ TG	↓ HDL
Renal disease	Varies		
Therapeutic diet: ketogenic; high carbohydrate	↑ LDL	↑ TG	
Transplant (bone marrow, heart, kidney, or liver)		↑ TG	↓ HDL

There are several secondary causes of abnormal lipids that may occur in adolescence. Children small for gestational age as infants have been shown to have higher levels of cholesterol, especially those who exhibit poor catch-up growth.¹⁰ The starved state that occurs in anorexia nervosa and the use of anabolic steroids are both associated with abnormal lipids. Certain medications for acne, seizure disorders, immunosuppression, and contraception can adversely affect lipids as can a high carbohydrate diet or a ketogenic diet sometimes prescribed for refractory epilepsy. Adolescents with a history of a transplant also tend to have an abnormal lipoprotein panel despite a TC in the normal range.

Dietary Assessment

A comprehensive nutritional evaluation should involve the adolescent as well as relevant family members. Even older adolescents in charge of their own meals should have family members involved in parts of the assessment and counseling.

Assessment of the Individual

Three day food records should be filled out before the appointment when possible. When three-day food records are not feasible to utilize, a “typical day” recall for school and non-school days or a brief food frequency are alternatives (see Chapter 4). Using the records and probing for accuracy, the interviewer can provide a snapshot of current intake and potential obstacles to adherence. The dietary assessment should include:

- Usual food choices at home, especially sources of saturated fat and cholesterol
- School food choices including those from vending machines, snack bars, and school lunch and/or breakfast
- Food choices away from home (convenience stores, fast food restaurants, movies, etc.)
- If overweight, sources of low nutrient-dense foods
- Physical activity: type, frequency and duration

Assessment of the Family

Interviewing parents or guardians can enhance the individual records as well as provide background on:

- Household responsibilities for food purchasing and preparation, school lunches
- Flexibility of family to buy, prepare, and try lower fat foods
- Frequency of family meals
- Type of foods available at home including traditional ethnic foods, snack foods, and soft drinks
- Frequency of eating out and type of restaurants

Identify CHD Risk Factors

In tandem with the nutritional assessment, the adolescent's medical history and exam may reveal other risk factors.

Family History: Premature CHD in primary relative

Personal Medical History: Diabetes (type 1 or 2)

Health Behavior History: Cigarette smoking
Alcohol use
Physical inactivity

Physical Exam: Obesity (BMI \geq 95th percentile for age and gender)
Hypertension
Clinical signs of familial lipid disorders: palmar or tendon xanthoma, xanthelasma (eyelid)

INTERVENTION**Indications for Treatment**

NCEP's 1991 guidelines apply to adolescents with either a positive family history of CHD or parental hyperlipidemia. Recommendations for intervention vary depending upon the degree of elevation of the adolescent's levels of LDL or TC (see Table 1 for criteria). The AAP's 1998 guidelines are consistent with NCEP, but use only the LDL level to make treatment decisions.³

- **Acceptable LDL or TC:** preventive dietary guidelines (see primary prevention) and risk factor reduction counseling.
- **Borderline LDL or TC:** AHA Step 1 diet plus risk factor reduction counseling.
- **High LDL:** Intensive nutrition assessment and instruction on AHA Step 1 diet with advancement to Step 2 diet if LDL still elevated after three months.
 - AAP recommendations for adolescents with "high" LDL also include ruling out secondary causes of elevated lipids and conducting lipid screening on all family members.

The NCEP ATP III Guidelines for Adults⁸ consider triglycerides as an independent risk factor for CHD and target weight reduction and increased physical activity for those with borderline TG levels (150-199 mg/dl). Specific recommendations have not been made for adolescents with hypertriglyceridemia, except for those with diabetes and elevated TG.¹¹

Past interventions with youth have confirmed the safety and efficacy of a low fat diet.⁶ As long as energy intake is sufficient, and nutrient-dense foods are selected, a low fat, low cholesterol diet supports growth and development. Specific dietary recommendations include:

- **Decreased intakes of saturated fat:** Reducing saturated fat is considered to have the most impact in lowering LDL. Sources include stick margarine, partially hydrogenated oils and fats, hydrogenated peanut butters, commercial bakery products, commercial fried food (e.g., French fries) and high fat animal products.
- **Decreased intakes of *trans*-fatty acids:** *Trans*-fatty acids are thought to increase LDL levels nearly as much as saturated fat and appear to lower HDL.
- **Decreased intakes of dietary cholesterol:** Although individual responsiveness to dietary cholesterol varies, it is still considered important in LDL reduction. Diabetic patients may be more sensitive to dietary cholesterol intake,⁴ which is only found in animal products.
- **Encourage a low to moderate total fat intake:** Currently the specific type of fat consumed is emphasized over the total fat intake which was once considered to be the most important factor in lowering cholesterol. The AAP and AHA have placed upper and lower limits on fat intake to prevent nutrient deficiencies possible with very low fat diets and to avoid possible adverse effects of high carbohydrate diets upon HDL and TG.⁴
- **Balance the fatty acid composition of diet:** Polyunsaturated and monounsaturated fatty acids can lower LDL and are suggested as substitutes for saturated fats.
- **Encourage omega-3-fatty acid consumption:** Because of their association with lower TG and other cardio protective effects, the AHA recommends at least 1 fatty fish meal or other source of omega 3-fatty acids per week.
- **Increase dietary fiber intake:** Soluble fiber can contribute to LDL reduction and is now a formal part of hyperlipidemia dietary recommendations.⁴ Fruits, vegetables, cereals, oats, whole grains, and legumes are good sources of soluble fiber.
- **Encourage antioxidant food sources:** Carotenoids and vitamins C and E have been associated with lower CHD risk. Recommend antioxidant-rich foods such as whole grains, citrus fruits, melons, berries and dark orange/yellow or leafy green vegetables rather than supplements.
- **Reduce serum homocysteine levels:** Higher blood levels of homocysteine are associated with greater CHD risk. Adequate intakes of folate and vitamins B₆ and B₁₂ as well as total fat restriction may keep homocysteine levels low.¹² Food sources of these nutrients include fruits, dark green and leafy vegetables, fortified cereals, whole grains, lean meats and poultry.
- **Plant sterols are not recommended:** Plant-sterol-containing foods are associated with lower LDL, but may decrease the absorption of fat-soluble vitamins. The AHA recommends these foods, such as “cholesterol-lowering” margarine-type spreads and salad dressings, mainly for adults,¹³ and should only be used by adolescents who are hyperlipidemic and monitored closely for growth.

Other Risk Factor Recommendations

- **Maintain a healthy body weight:** Recent recommendations stress weight management to optimize LDL, HDL and TG levels. (See the discussion later in this chapter on special subgroups requiring modifications to treatment plan.)
- **Increase physical activity**
- **Quit smoking (if applicable)**

Nutrition Counseling

- Explain the association between elevated lipids, dietary changes and CHD risk.
- Instruct adolescents to follow the NCEP Step 1 diet for three months (see Table 4). If LDL has not improved to borderline or to acceptable levels and adherence to Step 1 has been maintained, further restrict saturated fat and dietary cholesterol and move to a Step 2 diet (<7% of the calories from saturated fat and <200 mg cholesterol). Optimally, a nutritionist or registered dietitian should provide lipid-lowering counseling.¹
- Individualize dietary recommendations for the adolescent, considering his/her food preferences, lifestyle, ethnicity and family situation.
- Help the adolescent set initial goals using dietary assessment information (Table 5).

TABLE 4
NCEP Step-One Dietary Guidelines

Food Group	Age of Child			
	Ages 11-14		Ages 15-18	
	Females	Males	Females	Males
Meat, poultry, fish (oz)	6	6	6	6
Eggs per week	3	3	3	3
Dairy products (sv)	4	4	4	4
Fruits (sv)	3	3	5	3
Vegetables (sv)	4	3	4	3
Bread, cereals (sv)	9	8	12	8
Fats, oils (sv)	7	5	10	5
Sweets, modified fat desserts	4	3	4	3

Serving Size

Dairy: 1 c milk or yogurt, 1 oz cheese, 1/2 c dairy dessert

Fruits: 1 med piece, 1/2 c juice

Vegetables: 1/2 c raw or cooked, 1 c salad

Breads, cereals: 1 slice bread, 1 tortilla, 1/2 c rice or pasta, 1 muffin, 4" pancake

Fats, oils: 1 tsp oil or margarine, 1 Tb salad dressing

Sweets: 6 oz sugared drink, 3/4 oz hard candy, 2 cookies, 1 slice cake, 1 1/2 Tb jelly

TABLE 5
Goals for Nutrition Counseling for Adolescents with Hyperlipidemia

Food Purchasing and Preparation

- Choose lower fat foods
- Substitute lower fat ingredients in cooking (non-fat milk, yogurt, egg white, chicken broth)
- Use less partially hydrogenated fats or tropical oils, or products containing them
- Bake or broil instead of frying
- Serve fruit and vegetables at each meal
- Buy less chocolate and regular baked goods
- Train family food shopper(s) in label reading
- Consider low fat cooking or label reading class

Food Choices

Increase use of

- Seafood, skinless chicken and turkey, beans
- Non-fat and 1% low fat dairy products
- Fruits and vegetables
- Whole grains: bread, bagels, rice, pasta, cereal
- Lower fat spreads: low fat sandwich spread, fruit spreads, light cream cheese

Decrease use of

- Bacon, ground beef, other high-fat meats
- Egg yolks
- Ice cream, whole milk, cheese
- Butter, *trans*-fat margarines, mayonnaise
- Cookies, muffins, cupcakes, doughnuts, cheese crackers
- Chocolate candy

Eating and Related Behavior

- Frequent family meals
- Pack school lunches with appropriate foods
- Adapt cultural and ethnic food patterns
- Choose lower fat food choices when eating out
- Eat at fast food restaurants less often
- Daily fitness activity
- Set realistic weight management goals if overweight

Psychosocial

- Family is supportive of lifestyle changes
- Parents model health lifestyle behaviors

- Food lists or sample menu plans can be personalized to show teens how to incorporate favorite foods and balance intake to meet dietary guidelines. Table 6 shows selected foods relative to the total saturated fat and cholesterol allotment for the day.
- Provide additional resources for the family to turn to for assistance or further information (see Resources section at the end of this chapter).
- Involve the family to encourage support of the adolescent in making changes. Dietary recommendations to reduce lipid levels are judged safe for individuals over the age of 2 years so that most of an adolescent's family can adopt the same changes.

TABLE 6
Saturated Fat, Dietary Cholesterol, and Caloric Content of Selected Foods*

Food item (1 average serving)	Saturated fat (g)	Dietary Cholesterol (mg)	Calories (kcal)
Burgers			
Cheeseburger, extra large	19	120	810
Cheeseburger, 1/4 pound	13	95	530
Hamburger, small	4	40	285
Chicken			
Grilled chicken sandwich	5	105	530
Chicken tenders, fried (1 average serving)	5	80	430
Fried chicken, crispy (1 leg and 1 thigh)	10	195	575
French fries			
Regular serving size	4	0	450
Pizza			
Pan pizza, cheese	5.7	11	361
Pan pizza, deluxe meat	7.3	29	428
Pan pizza, "vegie"	3.9	7	333
Mexican			
Burrito, beef	9	60	510
Quesadilla, cheese	9	50	350
Taco, beef	4	30	170
Sandwiches			
Italian submarine	16	85	800
Roast beef and Swiss cheese	14	90	730
Club	7	75	718
Turkey breast	3	57	476
Dairy			
Nonfat milk or plain yogurt (8 oz)	0.3	4	86
Low fat 1%	1.6	10	102
Low fat 2%	2.9	18	121
Whole	5.1	33	150
Mozzarella cheese (part-skim) (1 oz)	2.9	16	72
Cheddar	5.6	27	106
Ice cream (12% fat)	4.5	30	135
Frozen yogurt	1.5	9	123
Meat and protein foods			
Bacon	5	124	163
Hot dog (1 oz)	3.1	14	91
Salami	3.5	22	119
Egg (1)	1.5	215	70
Peanut butter (2 Tb)	2.7	0	189
Fats			
Mayonnaise (1 Tb)	1.6	8	99
Butter (1 tsp)	2.5	11	36
Total daily intake recommended (NCEP):			
2000 kcal daily intake: Step 1 (10% saturated fat)	22.2 g	300 mg	2000
Step 2 (7% saturated fat)	15.6 g	200 mg	2000
1500 kcal daily intake: Step 1 (10% saturated fat)	16.7 g	300 mg	1500
Step 2 (7% saturated fat)	11.7 g	200 mg	1500

*Note: Nutrient content information is based upon published fast food information cite and government nutritional information databases cite and actual content may vary considerably.

Translating recommendations into food choices

Dietary guidelines for hyperlipidemia call for food choices that are low in saturated and trans-fatty acids and low in dietary cholesterol, and include good sources of omega-3-fatty acids, soluble fiber, carotenoids, folic acid, and vitamins B₆, B₁₂, C, and E. This means very little to adolescents asked to make major changes in their eating pattern. Converting the dietary recommendations into everyday food choices is key in helping the teen and the family adhere to the dietary guidelines.

Table 3 summarizes the NCEP recommendations for adolescents in terms of food group servings and more specific food choice guidelines are provided in Table 4. Basic tenets of these are:

- **Include** more fish, whole grains, breads, and cereals, fruit and vegetables.
- **Substitute** complex carbohydrates or starches (if TG are normal) and unsaturated vegetable fats for animal fats and foods made with hydrogenated or tropical oils (palm, palm kernel, coconut).
- **Substitute** nonfat or low fat dairy and meat choices for high saturated fat types of each.

Special Subgroup Modifications

Diabetic adolescents need to achieve glycemic control as well as reduce dietary saturated fat and cholesterol.

- There is controversy regarding how strict hyperlipidemic diabetics need to be about the glycemic index of foods. Patients would have to limit complex and simple carbohydrates as well as fat intake,^{4,11} making adherence very difficult for adolescents. Where possible, they should replace saturated fat with unsaturated fat rather than with carbohydrate to avoid elevations in TG.
- Increase physical activity.
- Higher fiber intake may improve both glucose control and blood lipid levels.⁴
- Weight management is important because of its impact upon blood lipids and diabetes.
- Monitor CHD risk factors in all children with diabetes.

Obese adolescents who adhere well to the dietary and fitness modifications for hyperlipidemia may experience moderate weight loss and an improved lipid profile. Although weight loss is not usually recommended until after pubertal growth has been completed, an overweight adolescent gaining weight on a lipid lowering food plan should be encouraged to:

- Decrease low nutrient-dense foods which may be low in fat, but are mainly contributing energy, such as:
 - “fat free” bakery goods or snack foods
 - “fruit” snacks
 - sugared candy or cereals
 - sweetened soft drinks or “fruit” drinks
 - sweetened dairy products

- Reinforce recommendations for daily fitness and assure that the type of physical activity chosen is accessible and realistic for the adolescent. Regular physical activity should be in addition to school physical education and should include the family.
- Check portion sizes and quantity of foods. Read labels and check serving sizes.
- Decrease frequency of eating out and improve choices made when eating away from home.
- Consider a group weight management program that is tailored to adolescents and does not restrict calories.

Adolescents with hyperlipidemia living away from home (group homes, juvenile justice, boarding school, college) face a major challenge in gaining access to appropriate foods. In some settings, foods may be excess commodities or from warehouse grocery stores, where low saturated fat food choices are limited. Food preferences of the group and economic realities may preclude buying two different fat levels of milk or meat. In addition, some facilities reward positive youth behavior with candy or other treats.

- Health professionals may impact food availability by writing a medical prescription for a low saturated fat diet. Adolescents can not be expected to communicate the dietary regimen to their caretakers.
- A brief meeting between a facility administrator, the health professional, and food service manager can facilitate change.
- Health center personnel at boarding schools or colleges can be asked to implement the prescribed diet and attempt to improve access to low fat foods.

Adolescents with renal disease may be on low protein, high calorie diets or on high protein diets if on dialysis. Both require vigilance regarding the amount of saturated fat and dietary cholesterol. Measure lipoproteins, not TC, in all post-transplant patients because of the high prevalence of dyslipidemia.

Adolescents with eating disorders may experience hypercholesterolemia during the course of their illness. It is prudent to monitor lipids in those with eating disorders, especially anorexia nervosa, as fat mobilization in the starved state can be associated with higher blood lipids. Cholesterol levels vary inversely with BMI and are often more elevated during the early stages of treatment. If there is significant CHD risk in an eating disorder patient, considering family history and other risk factors, intervention must proceed with caution. Dietary restrictions of an anorexic patient may validate their restrictive approach to food intake and further threaten nutritional adequacy.

Dietary Adherence

Multiple factors affect the ability of adolescents to adhere to dietary restrictions of saturated fat and dietary cholesterol. Adolescents have been shown to comply with the Step 1 diet, leading to a decrease in serum cholesterol without affecting growth.¹ Motivation, food preferences, family support, the attitude of health care providers, and access to appropriate food choices are among the myriad of influences on adherence. Since there are no symptoms with hyperlipidemia, more pressure is placed on the provider to be persuasive in relating the importance of dietary change and cholesterol reduction.

Good adherence requires preplanning and making complex decisions at each meal. The health care professional can help the adolescent prioritize and work on dietary changes that are likely to have the greatest impact. Switching from whole to 1% fat milk (or 2% to nonfat) three times a day will make a greater contribution to lowering saturated fat and dietary cholesterol than switching from regular to turkey hot dogs if they are usually eaten only twice a month. Information from the dietary assessment can elucidate the largest contributors of saturated fat and cholesterol for each patient. Ideally, teens should attempt to follow the entire dietary regimen, but it is more realistic to identify a few significant behaviors as likely starting points for intervention:

Food choices at home: Comparing trends in food habits from national surveys, adolescent consumption of some sources of saturated fat and cholesterol has decreased, but the intake of foods thought to be protective against heart disease has also decreased.¹⁴ Fruit and vegetable consumption is down, with the exception of high fat potatoes (French fries, potato chips), which comprise half of current vegetable consumption. Milk intake by adolescents has dropped sharply and has been replaced by fruit juice, soft drinks, and other sweetened beverages. High fat, grain-based dishes such as pizza and macaroni and cheese have increased substantially, but not whole grain intake. The top contributors of fat in adolescent diets are yeast breads, cakes, cookies, quick breads and muffins, donuts, beef, milk and cheese.¹⁵ To maximize adherence at home:

- Assist teens in identifying the major sources of saturated fat from the dietary assessment.
- Help teens find acceptable substitutes for fatty foods.
- Encourage decreased portion sizes of favorite foods that are high in saturated fat.
- Suggest trying different fruits and vegetables and help teens identify several that they will eat routinely.
- Encourage adolescents to make lower fat milk, meat or cheese choices.
- Provide ideas for healthy snack foods such as bagels, pretzels, baked chips, and ready-to-eat cereal.

Regular family mealtime: In a recent study, youth (ages 9-14) who ate dinner with their family frequently had a healthier food intake, including less fried food, less saturated fat, less *trans* fat, more nutrient density and more dietary fiber.¹⁶

- Train household members to make low fat food choices and to use cooking techniques.
- Suggest family members share responsibility for meal planning and cooking.
- Help families plan around schedules to increase the number of family meals.

Eating out: Food eaten away from home in 1998 accounted for almost half of family food budgets.¹⁴ Convenience, taste, and affordability are major factors in the popularity of eating out, especially “fast foods.”¹⁵

- Help teens eat out less frequently by teaching them how to make simple healthy meals at home.
- Suggest restaurants with a variety of lighter choices.
- Encourage teens to eat smaller portions of high fat foods or choose lighter alternatives.

Evaluating Adherence

To assess compliance with the dietary recommendations, have adolescents complete another three-day food record and review it with them, probing for missing information. Using the nutrition goals from Table 5, review the food record with the adolescent and decide for each goal if it has been mastered, is “in progress” or not attempted yet. If substantial dietary changes have been made, follow-up lipids are usually improved, unless the adolescent has a familial lipid disorder. Regardless of lipid results, adolescents should get positive feedback for their efforts.

Detailed computer dietary analysis is not required to judge patient adherence, but can be used if it is available, if used carefully. Adolescent eating habits can be erratic and food records for two or three days do not accurately reflect the overall intake of a teen. The summaries of fat and cholesterol intake merely reflect what was consumed on those days. In addition, the amount of “extras” in the diet can mislead the evaluation of fat intake. A teen consuming 2000 calories a day and 25 grams saturated fat has over 11% of their total calories from saturated fat; if he drinks two soft drinks, his calories are 2300 per day and the same 25 grams of fat now yields a diet with 9.8% of the calories from saturated fat and meets dietary guidelines. Using food survey data, Guthrie found that added sweeteners like soft drinks, other drinks, and sweetened foods accounted for 20% of adolescent calories.¹⁷ This presents methodological issues for measuring adherence, and points out other avenues for intervention, especially in overweight and diabetic adolescents.

Follow Up and Monitoring

- Check LDL 3-6 months after dietary intervention has started and annually thereafter.⁶
- Move to the Step 2 NCEP diet if Step I dieting changes are not sufficient to reduce LDL levels. Closely monitor the adolescent on the Step 2 eating plan for nutritional adequacy.
- Adolescents with diabetes should have a lipid profile done when diagnosed and regular lipid monitoring thereafter, more frequent if glucose control is not achieved.¹¹
- For adolescents with very high carbohydrate intake (> 60% of calories), monitor for a decreased HDL or increased TG.⁴

Referral

Nutrition counseling for hyperlipidemia by a nutritionist or registered dietitian is preferred, and essential for poor lipid response or compliance difficulties. Youth with familial lipid disorders should see specialists in lipid metabolism.

Drug Therapy

The NCEP and AAP suggest considering drug treatment in children over 10 years after a 6-12 month trial of dietary therapy and risk factor intervention if: 1) LDL is still ≥ 190 or 2) LDL is >160 and there is either a family history of premature CHD or the adolescent has two or more CHD risk factors (low HDL, smoking, hypertension, obesity, diabetes). Adolescents taking cholesterol-lowering medications should still follow the dietary regimen for maximum effect.

Until recently, bile-acid binding resins, such as cholestyramine, were the main agents used with adolescents. Statins, HMG-CoA reductase inhibitors, are effective in LDL-lowering and may increase HDL. They are generally well-tolerated, although they have mostly been studied in male adolescents.¹⁸ Some of the medicines used have nutrient interactions that need to be factored in to the dietary recommendations.

Bile-acid binding resins

- Decrease LDL and increase HDL levels; may increase TG.
- GI disturbances (bloating, gas, abdominal pain constipation and heartburn) are common and hard to tolerate. Mixing the drug packet with applesauce or juice may make it more palatable.
- Absorption of various vitamins and minerals as well as certain medications such as iron, tetracycline, and penicillin is reduced. Therefore, bile acid binding resins should be taken 1 hour before or 6 hours after meals.¹⁹

Statins

- Decrease LDL, decrease TG, and increase HDL.
- Alcohol and grapefruit juice should be avoided when taking statins as they may interact with the medication.
- Statins need to be taken with the evening meal or at bedtime.
- Statins can be associated with mild liver enzyme elevations, GI disturbances, headaches, myalgias, and rash. It is important not to dismiss complaints of muscle aches in youth taking statins as it may indicate a rare side effect, rhabdomyolysis.

Nicotinic acid (Niacin)

- Decrease LDL, decrease TG, increase HDL.
- Flushing, GI discomfort, and glucose intolerance are the most common side effects.

PREVENTION**Secondary Prevention: Selective Lipid Screening**

Lipids and lipoproteins are not routinely checked in adolescents and are left to the discretion of the physician. Most screening recommendations suggest measuring lipids in teens that have a strong family history or two or more CHD risk factors.

Primary Prevention: Population-wide Dietary Recommendations

There is little difference between initial dietary recommendations for hyperlipidemia and those for all healthy individuals over the age of 2. There is recognition that everyone carries some risk of acquiring CHD and its morbidities. The population-wide recommendations promote lifestyle changes along with identifying and modifying risk factors for heart disease. In 2000 the AHA revised its guidelines, which place emphasis on foods rather than nutrients and added weight management as a goal. The AHA guidelines include:

- $\leq 30\%$ of calories from total fat intake.
- $< 10\%$ of calories from saturated fat intake.
- < 300 mg dietary cholesterol intake/day.
- Two servings of cold water fish per week that are high in omega 3-fatty acids.
- Increase consumption of fruits, vegetables, and low fat and fat-free dairy products.

- Substitute whole grains, vegetables, fish, legumes and nuts for saturated fat.
- Limit salt to <6 grams per day.
- Limit alcohol ≤ 2 drinks per day men, ≤ 1 drink per day women.
- Maintain a healthy body weight.
- Increase physical activity.
- Consume a diet which contains adequate potassium, calcium, and magnesium to facilitate blood pressure control.

The 2000 US Dietary Guidelines²⁰ also took the focus off of total fat calling the diet “moderate” fat to emphasize saturated fat and cholesterol reduction; they also added a reduction in *trans* fat.

RESOURCES: INTERNET SITES

American Diabetes Association

<http://www.diabetes.org/>

Professionals: Clinical practice, recommendations

Public: Nutrition, exercise, recipes, virtual grocery

American Heart Association

<http://www.americanheart.org/presenter.jhtml?identifier=704>

Professionals: An office-based practical approach to the child with hypercholesterolemia

<http://www.deliciousdecisions.org/>

Public: Nutrition tips and virtual cookbook for heart health

Cyberdiet

<http://www.cyberdiet.com/>

Fast Food Quest: nutrient information for 35 restaurants

National Heart Blood and Lung Institute

<http://www.nhlbi.nih.gov/>

Click on “Health Information”

Health Information for public: cholesterol, obesity

Health Information for professionals: NCEP ATP III, Overweight and obesity

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