Chapter 11

HYPERTENSION

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Essential, or primary hypertension is a persistent elevation of blood pressure which is not caused by underlying cardiac, endocrine, or renal disease.[1] Approximately 70% of blood pressure elevations in youth represent early onset of essential hypertension.[1,2]

- Adolescents 17 years of age or younger are considered to be hypertensive if their average systolic and/or diastolic blood pressure measurements on three visits are at or above the 95th percentile for age, gender and height (Tables 1, 2, 3).[3]
- Adult standards are used to evaluate blood pressure elevations in adolescents who are 18 years or older (Table 4).[4] An average of at least two diastolic blood pressures 90 mm Hg or higher on two or more visits, or an average of multiple systolic blood pressures taken two minutes apart at two or more visits (after an initial screening) at or above 140 mm Hg is used to define stage 1 through 3 hypertension.
- Body size is an important determinant of blood pressure; tall adolescents normally have higher blood pressures than those who are short.[3]

TABLE 1
Blood Pressure Levels for the 90th and 95th Percentiles of Blood Pressure for Adolescent Males through 17 Years of Age by Percentiles of Height

Age	Height %tiles* BP**	Systolic BP (mm Hg)							Distolic BP (mm Hg)						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
10	**90th**	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95th	115	116	117	119	121	122	123	77	78	79	80	81	81	82
11	**90th**	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95th	117	118	119	121	123	124	125	78	78	79	80	81	82	82
12	**90th**	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95th	119	120	122	123	125	127	127	78	79	80	81	82	82	83
13	**90th**	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	95th	121	122	124	126	128	129	130	79	79	80	81	82	83	83
14	**90th**	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95th	124	125	127	128	130	132	132	80	80	81	82	83	84	84
15	**90th**	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95th	126	127	129	131	133	134	135	81	81	82	83	84	85	85
16	**90th**	125	126	128	130	131	133	134	78	78	79	80	81	82	82
	95th	129	130	132	134	135	137	137	82	83	83	84	85	86	87
17	**90th**	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	95th	131	132	134	136	138	139	140	84	85	86	87	87	88	89

*Height percentile determined by standard growth curves.
**Blood pressure percentile determined by a single measurement.

Source: National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. Fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics 2004;114(2):555-576. This supplement is a work of the US government, published in the public domain by the American Academy of Pediatrics. Available at http://www.pediatrics.org/cgi/content/full/114/2/S2/555.

TABLE 2
Blood Pressure Levels for the 90th and 95th Percentiles of Blood Pressure for Adolescent Females through 17 Years of Age by Percentiles of Height

Age	Height %tiles* BP**	Systolic BP (mm Hg) 5%	10%	25%	50%	75%	90%	95%	Distolic BP (mm Hg) 5%	10%	25%	50%	75%	90%	95%
10	**90th**	112	112	114	115	116	118	118	73	73	73	74	75	76	76
	95th	116	116	117	119	120	121	122	77	77	77	78	79	80	80
11	**90th**	114	114	116	117	118	119	120	74	74	74	75	76	77	77
	95th	118	118	119	121	122	123	124	78	78	78	79	80	81	81
12	**90th**	116	116	117	119	120	121	122	75	75	75	76	77	78	78
	95th	119	120	121	123	124	125	126	79	79	79	80	81	82	82
13	**90th**	117	118	119	121	122	123	124	76	76	76	77	78	79	79
	95th	121	122	123	124	126	127	128	80	80	80	81	82	83	83
14	**90th**	119	120	121	122	124	125	125	77	77	77	78	79	80	81
	95th	123	124	125	126	127	129	129	81	81	81	82	83	84	84
15	**90th**	120	121	122	123	125	126	127	78	78	78	79	80	81	81
	95th	124	125	126	127	129	130	131	82	82	82	83	84	85	86
16	**90th**	121	122	123	124	126	127	128	78	78	79	80	81	81	82
	95th	125	126	127	128	130	131	132	82	82	83	84	85	85	86
17	**90th**	122	122	123	125	126	127	128	78	79	79	80	81	81	82
	95th	125	126	127	129	130	131	132	82	83	83	84	85	85	86

*Height percentile determined by standard growth curves.
**Blood pressure percentile determined by a single measurement.

Source: National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. Fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics 2004;114(2):555-576. This supplement is a work of the US government, published in the public domain by the American Academy of Pediatrics. Available at http://www.pediatrics.org/cgi/content/full/114/2/S2/555.

TABLE 3
Classification of Hypertension in Children and Adolescents, with Measurement Frequency and Therapy Recommendations

	SBP or DBP %tile*	Frequency of BP Measurement	Lifestyle Changes
Normal	<90th	Recheck at next scheduled physical examination	Encourage healthy diet, sleep, and physical activity
Prehypertension	90th to <95th or if BP exceeds 120/80 even if <90th %tile up to <95th%tile**	Recheck in 6 mo	Weight-management counseling if overweight; introduce physical activity and diet management
Stage 1 hypertension	95th-99th %tile plus 5 mm Hg	Recheck in 1-2 wks or sooner if the patient is symptomatic; if persistently elevated on 2 additional occasions, evaluate or refer to source of care within 1 mo	
Stage 2 hypertension	>99th %tile plus 5 mm Hg	Evaluate or refer to source of care within 1 wk or immediately if the patient is symptomatic	

*For gender, age, and height measured on at least 3 separate occasions; if systolic and diastolic categories are different, categorize by the higher value.
**This occurs typically at 12 years old for SBP and at 16 years old for DBP.

Source: Reprinted from National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. Fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics 2004;114(2):555-576. This supplement is a work of the US government, published in the public domain by the American Academy of Pediatrics. Available at http://www.pediatrics.org/cgi/content/full/114/2/S2/555.

TABLE 4
Classification of Hypertension in Adolescents Ages 18 Years and Older

Blood Pressure Classification	Blood Pressure (mmHg) Systolic	Diastolic	Lifestyle Modification
Normal	<120	and <80	Encourage
Prehypertension	120-139	or 80-89	Yes
Stage 1 hypertension	140-159	or 90-99	Yes
Stage 2 hypertension	≥ 160	or ≥100	Yes

Source: Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. NIH Pub #04-5230. National High Blood Pressure Education Program, National Heart, Lung, and Blood Institute, National Institutes of Health; 2004. http://www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.htm

- Blood pressures below the 90th percentile in adolescents under 18 years of age, and under 120/80 mmHg in older adolescents are considered normal.
- Adolescents with blood pressure readings between normal and hypertensive ranges (high-normal), are at risk for hypertension and should be frequently monitored.[2]
- The prevalence of essential hypertension is highest in obese adolescents, and in those of African American and Asian decent.[1]

SIGNIFICANCE

Approximately one in four US adults have high blood pressure, which if untreated places them at increased risk for morbidity and mortality from cardiac, vascular and renal disease (Table 5).[1,3,5] Cardiovascular disease is the first, and cerebrovascular disease the third leading cause of death in the United States.[4] Adolescents who experience elevated blood pressure levels are at increased risk for developing hypertension and its associated complications.

TABLE 5
Risks Associated with Hypertension

End stage renal disease	Adult essential hypertension and its associated morbidity appears to have its origins in childhood and adolescence.
Accelerated development of coronary artery disease	Untreated hypertension in youth frequently continues into adulthood.
Myocardial infarction	Cardiac, vascular and renal changes consistent with early stages of disease have been observed in hypertensive youth.
Congestive heart failure	Early identification and management of hypertension in youth may decrease premature morbidity and mortality in later life.
Stroke	
Peripheral vascular disease	
Ruptured aortic aneurysm	
Retinopathy	

ETIOLOGY

Beginning in fetal development, the interaction of genetic and environmental factors appear to influence the development of essential hypertension in youth.[6] Etiological factors correlated with hypertension in adults have also been associated with blood pressure elevations in youth (Table 6).[1,7]

TABLE 6
Factors Associated With The Development of Essential Hypertension

Intrauterine malnutrition	High alcohol intakes
Family history of hypertension	Tobacco use
Obesity, particularly excess abdominal fat	Drug use (e.g., cocaine, ecstasy, anabolic steroids)
Insulin resistance	Emotional stress
High dietary sodium intakes	Diet pill use
Low dietary intakes of calcium, potassium and magnesium	Oral contraceptives
Physical inactivity	

- An inadequate supply of nutrients may program changes in fetal structure and metabolism, increasing the risk of hypertension and other diseases in later life.[6]
- Most hypertensive adolescents are obese and have a family history of hypertension and obesity.[3] Obesity, which increases plasma volume and cardiac output, not only causes high blood pressure, but increases the risk of cardiovascular disease in adults.[3,7]
- Hyperinsulinemia and insulin resistance, which frequently occur in obese individuals, have been associated with the development of hypertension. In addition, elevated plasma insulin levels may cause sodium sensitivity.[7,8]
- Approximately 30-50% of individuals with hypertension are sodium-sensitive. Obese adolescents are more sensitive to the blood pressure-raising effects of sodium, which has been attributed to hyperinsulinemia, higher aldosterone levels, and increased activity of the sympathetic nervous system.[7,9] African Americans are also more likely to be sodium-sensitive.[9]
- Adequate dietary potassium, calcium, and magnesium intakes have been associated with lower blood pressure in youth.[1,10] A recent study found higher blood pressures in African American and Hispanic adolescents with low blood folate levels. Dietary intakes of potassium, calcium, magnesium, beta carotene, vitamins D and E, and select B vitamins were also lower in those with low folate intakes, while BMI and sodium intakes were comparable.[11]
- Potassium and calcium intakes are below recommended levels, particularly in adolescent females, while median intakes of phosphorus and protein, which promote calcium loss, are high.[12]
- Lack of physical activity may increase the risk of developing hypertension by 20-50%.[4]
- Substance use, including excessive alcohol intake, tobacco use, and drugs or medications with pressor effects such as steroids, oral contraceptives, cocaine, and diet pills or herbs containing stimulants, can significantly raise blood pressure levels.[1,4] Repeated blood pressure elevations and the production of vasoconstricting hormones by the nervous system in response to stress can cause hypertension.[13]

SCREENING

Hypertension is asymptomatic. Blood pressure measurement is recommended in all youth at routine health maintenance visits and at other medical visits to screen for hypertension.[3]

- Blood pressure is measured with a standard blood pressure cuff of the correct size (i.e., width of bladder within the cuff is approximately 40% of the right mid upper arm circumference, and bladder length encircles at least 80% of the mid upper arm.) A cuff that is too large will usually not mask true hypertension, while a cuff that is too small may falsely elevate blood pressure readings.[1,3]
- The adolescent should be seated for at least five minutes, legs uncrossed, with the arm supported at heart level.[3]
- The blood pressure should be taken at least twice on each occasion and the average of the measurements used.[3]
- Tobacco and caffeine should be avoided for at least 30 minutes prior to the blood pressure measurement.[4]

Adolescents with consistently high blood pressures should be further evaluated to identify contributing environmental factors and morbidity associated with hypertension (see Table 7).

TABLE 7
Assessment of Adolescents with Hypertension

Body mass index and percentile for gender and age ▪ Overweight (BMI>95th percentile) ▪ Distribution of body fat	Physical activity level ▪ Aerobic exercise (type, frequency, duration) ▪ Sedentary activities (e.g., TV viewing, computer use)
Fasting lipid panel ▪ Total, HDL and LDL cholesterol ▪ Triglyceride levels	Dietary intakes of sodium, potassium, calcium (mg) ▪ Fast food, salty snacks, salt shaker, condiments ▪ Fruits and vegetables ▪ Dairy products
Fasting plasma glucose	Psychosocial stress level
Tobacco, alcohol and drug use	Family history of hypertension

INTERVENTION

Lifestyle modification is the initial intervention strategy in the management of elevated normal blood pressure and mild to moderate hypertension. Significant hypertension may also require antihypertensive medication.[4]

- Weight loss in obese, hypertensive youth effectively lowers both systolic and diastolic blood pressure, particularly when combined with aerobic exercise. In addition, a decrease in body fat improves lipid profiles and carbohydrate status and decreases the effect of dietary salt on blood pressure.[1,4,7,11] Efforts to lower body weight should focus on increased physical activity and dietary changes to lower excess energy intake (see Chapter 7). Appetite suppressants should be avoided, since they may elevate blood pressure. Since a weight loss of only ten pounds has been demonstrated to lower blood pressure in obese, hypertensive adults,[4] significant weight loss is not necessary (or desirable in young, growing adolescents) for blood pressure control.

- Low to moderate intensity aerobic exercise for 30 to 45 minutes, 6-7 times per week has a blood pressure lowering effect independent of weight loss.[4] Examples of such activities include biking, skating, rollerblading, brisk walking, swimming, etc. An increase in physical activity will also improve cardiovascular health, lipid profiles and insulin sensitivity.[14] Sports participation and strenuous physical activity are usually not contraindicated in hypertensive adolescents.[3] Power lifting and intensive weight training, however, have a pressor effect and can raise blood pressure.[15]

- The DASH diet (Dietary Approaches to Stop Hypertension) has been shown to significantly reduce blood pressure in hypertensive and normotensive individuals, particularly in African Americans.[16] This dietary strategy emphasizes fruits, vegetables, nuts, whole grains, low fat dairy products, fish and poultry (sources of potassium, calcium and magnesium), and is low in saturated fat, cholesterol, sugar and refined carbohydrates (Table 8). When combined with a reduction in dietary sodium, the DASH diet was approximately twice as effective in lowering blood pressure at the lowest level of sodium intake (1500 mg/day).[17]

- Stress management and relaxation therapy, as part of a healthy lifestyle, may also be of some benefit in lowering blood pressure in hypertensive adolescents.[18]

If lifestyle changes are not effective in lowering blood pressure after approximately one year, antihypertensive drugs are indicated. The above nonpharmacologic approaches, however, continue to be an important component of hypertension management in combination with drug therapy.

TABLE 8
DASH Eating Pattern

Food Group	Servings/day*	Serving Sizes
Grains and grain products	7-8	1 slice bread; 1/2 c pasta, rice, cereal
Vegetables	4-5	1 c raw leafy; 1/2 c other (raw or cooked), 3/4 c juice (low sodium)
Fruits	4-5	1/2 c, 1 medium fresh, 1/4 c dried, 3/4 c juice
Dairy products (low fat/fat-free)	2-3	1 c milk or yogurt, 1 1/2 oz cheese
Lean meats, skinless poultry, fish	2 or less	3 oz broiled, roasted, grilled, steamed
Nuts, seeds, dry beans and peas	4-5/week	1/3 c nuts, 2 Tbsp seeds, 1 Tbsp nut butter; 1/2 c cooked beans, peas
Fats and oils	2-3	1 tsp soft margarine or vegetable oil, 1 Tbsp low fat mayonnaise, 2 Tbsp light salad dressing
Sweets	5/week	1 Tbsp sugar, syrup, jelly, jam, honey; 1/2 oz, 15 jelly beans

*Based on 2000 calories/day

Source: Facts about the DASH diet. NIH Publication No. 03-4082. National Heart, Lung and Blood Institute, National Institutes of Health; 2003. http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/ Accessed 12/10/04.

COUNSELING

Frequent (e.g., monthly) visits are useful in the management of hypertensive adolescents to monitor blood pressure, weight status (if overweight) and response to lifestyle modification. Food and activity journals kept by the adolescent for brief periods of time can help monitor progress in changing food and activity patterns. Topics to address in counseling the hypertensive adolescent are listed in Table 9.

TABLE 9
Counseling the Hypertensive Adolescent

Health risks of hypertension, in a non-threatening and motivating manner, if the adolescent is not yet ready to make behavioral changes
Relationship of obesity, physical activity and dietary choices to blood pressure status
Weight loss strategies, if overweight
Strategies to alter lipid patterns, if abnormal
Implementation of an aerobic exercise program
Adaptation of the DASH diet
Ways to increase fruit and vegetable intake
Reducing dietary sources of sodium
Reading food labels for sodium content and average portion size (some brands contain less sodium)
Healthy fast food and snack choices
Health risks of substance use
Smoking cessation, if applicable
Relaxation techniques
Stress management

It is important to teach teens to read labels when following a low sodium diet since many sources of sodium may not be obvious. Table 10 outlines nutrient claims for sodium modified products. This information can assist adolescents in choosing lower sodium foods.

TABLE 10
Nutrient Claim Guide For Sodium Content of Foods

Sodium/salt -free	Less than 5 mg sodium/serving
Very low sodium	35 mg or less sodium/serving
Low sodium	140 mg or less sodium/serving
Light in sodium/lightly salted	At least one-half as much sodium/serving as the same product which is not sodium-reduced
Reduced/less sodium	At least one fourth less sodium/serving than the same product which is not sodium-reduced

Since there is no practical way to determine salt sensitivity, a moderate reduction in sodium to 1500-2400 mg/day may be beneficial for youth with elevated blood pressures.[3] Average sodium intakes in the U.S. are in excess of 3600 mg/day. Primary sources of dietary sodium are processed, commercial and fast foods.[4] The taste preference for salt decreases after about three months of eating foods lower in sodium.[19]

Suggestions for dietary changes that can be used to reduce dietary sodium intake are listed in Table 11.

TABLE 11
Reducing Dietary Sodium

Replace the salt shaker on the table with a salt-free herb seasoning.
Use onion, garlic, herbs, lemon, spices, peppers and liquid smoke to season food while cooking, instead of salt.
Eat more fresh or frozen vegetables and home-prepared foods without salt.
Eat less processed, boxed, canned and frozen meals, side dishes and soups like macaroni and cheese, stuffing, instant noodles, chili, baked beans, spaghetti, TV dinners.
Eat fast food, Chinese food and pizza infrequently and choose foods lower in sodium.
Limit processed cheeses (e.g., American), cheese spreads and sauces.
Limit salty condiments like salt, seasoned salt, garlic salt, ketchup, mustard, soy sauce, teriyaki sauce, BBQ sauce, steak sauce, MSG.
Limit muffins, bagels, pastries, pancakes, waffles and donuts.
Limit snacks like salted chips, nuts, crackers, pretzels and popcorn, sunflower seeds, salsa and dips.
Limit cured, smoked, pickled and salted products like jerky, ham, cold cuts, deli meats, canned fish, lox, bacon, salt pork,sausage, hot dogs, brats, herring, pickles, olives and sauerkraut.

Adolescents frequently snack instead of eating meals. Adherence to a low sodium diet can be improved by providing teens with ideas for nutrient-dense snacks that are also low in sodium (Table 12).

TABLE 12
Snacks Lower in Sodium

Unsalted nuts and dried fruits (trail mix)	Ice cream, ice milk, ice cream bars
Unsalted soy nuts and dried cranberries	Frozen yogurt and fruit
Granola bar	Chocolate milk/hot chocolate
Sweetened rice cakes	Fudgsicle
Vanilla wafers	Pudding pop
Fruit leather	Frozen juice bars
Applesauce	Celery, natural peanut butter (lightly/unsalted)
Frozen banana	Unsalted chips, natural shredded cheddar cheese and jalapeno pepper
Fruited gelatin	

Teens are frequent consumers of fast foods and convenience foods, which are often high in sodium. Table 13 provides adolescents with a variety of food choices that can be useful in complying with a lower sodium diet.

TABLE 13 Fast Food Choices Lower in Sodium	
Small hamburger	French toast sticks
Small order of fries	6” roast beef/turkey/veggie sub with vinegar and oil
4 piece chicken nuggets, sweet and sour sauce	Small shake/Blizzard®/McFlurry®
Veggie/chicken pizza– thin crust	Small cone
Junior roast beef	Small sundae
Scrambled eggs	Fruit ‘n Yogurt Parfait®

Family Support

The hypertensive adolescent needs the positive support and role modeling of all family members. Their commitment to also make necessary lifestyle changes, including increased physical activity, smoking cessation, reduction in dietary sodium, and adopting the DASH eating plan will make it possible for the adolescent to be successful in managing hypertension.

REFERRAL

Adolescents with significant hypertension or obesity or those who are not successful in lowering their blood pressure may require intensive counseling from a registered dietitian or nutritionist. Referral to a public health nurse and/or coordination with the school nurse for on-going monitoring may also be useful. Smokers may benefit from an age-appropriate smoking cessation program. Those who abuse alcohol or other drugs may need referral to a chemical dependency counselor for in-depth evaluation and treatment.

PREVENTION

Efforts to prevent hypertension in youth are especially important for those with a family history of elevated blood pressures. Strategies include:[4,11]

- DASH eating plan
- Reduction of dietary sodium to less than 2300 mg/day
- Reaching/maintaining a healthy body weight
- Regular, aerobic exercise (30 minutes or more/day)
- Avoidance of substance use

RESOURCES

American Heart Association
http://www.americanheartassociation.org/

National Heart, Lung and Blood Institute
Facts about the DASH diet. NIH Publication No. 03-4082; 2003.
http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/

National Dairy Council
(DASH to the Diet)
10255 W Higgins Road, Suite 900
Rosemount, Il 60018-5616
http://www.nationaldairycouncil.org/

The American Dietetic Association
216 West Jackson Blvd
Chicago, Ill 60606-6995
A Dash of Prevention: An Easy, Great-Tasting Eating Plan That May Help Reduce Your Risk of High Blood Pressure
http://www.eatright.org/Public/NutritionInformation/92_nfs0899.cfm

REFERENCES

1. Bartosh SM, Aronson AJ. Childhood hypertension: an update on etiology, diagnosis, and treatment. Pediatr Clin North Am 1999;46(2):235-252.
2. National Heart, Lung, and Blood Institute. Report of the Second Task Force on Blood Pressure Control in Children-- 1987. Pediatrics 1987;79(1):1-25.
3. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. Fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics 2004;114(2):555-576. http://www.pediatrics.org/cgi/content/full/114/2/S2/555. Accessed 07/20/05.
4. Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. NIH Pub #04-5230. National High Blood Pressure Education Program, National Heart, Lung, and Blood Institute, National Institutes of Health; 2004. http://www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.htm. Accessed 07/20/05.
5. Daniels SR. Hypertension-induced cardiac damage in children and adolescents. Blood Press Monit 1999;4(3-4):165-170.
6. Osmond C, Barker DJ. Fetal, infant, and childhood growth are predictors of coronary heart disease, diabetes, and hypertension in adult men and women. Environ Health Perspect 2000;108 Suppl 3:545-553.
7. Carretero OA, Oparil S. Essential hypertension. Part I: definition and etiology. Circulation 2000;101(3):329-335.
8. Contreras F, Rivera M, Vasquez J, De la Parte MA, Velasco M. Diabetes and hypertension physiopathology and therapeutics. J Hum Hypertens 2000;14 Suppl 1:S26-31.

9. Kotchen TA, McCarron DA. Dietary electrolytes and blood pressure: a statement for healthcare professionals from the American Heart Association Nutrition Committee. Circulation 1998;98(6):613-617.

10. He J, Ogden LG, Vupputuri S, Bazzano LA, Loria C, Whelton PK. Dietary sodium intake and subsequent risk of cardiovascular disease in overweight adults. JAMA 1999;282(21):2027-2034.

11. Falkner B, Sherif K, Michel S, Kushner H. Dietary nutrients and blood pressure in urban minority adolescents at risk for hypertension. Arch Pediatr Adolesc Med 2000;154(9):918-922.

12. Federation of Associated Societies for Experimental Biology. Third Report on Nutrition Monitoring in the United States. Vol. 1. Washington, DC: US Government Printing Office; 1995.

13. Kulkarni S, O'Farrell I, Erasi M, Kochar MS. Stress and hypertension. Wis Med J 1998;97(11):34-38.

14. Hagberg JM, Park JJ, Brown MD. The role of exercise training in the treatment of hypertension: an update. Sports Med 2000;30(3):193-206.

15. American Academy of Pediatrics Committee on Sports Medicine and Fitness. Athletic participation by children and adolescents who have systemic hypertension. Pediatrics 1997;99(4):637-638.

16. Sacks FM, Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, et al. A dietary approach to prevent hypertension: a review of the Dietary Approaches to Stop Hypertension (DASH) Study. Clin Cardiol 1999;22(7 Suppl):III6-10.

17. Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. N Engl J Med 2001;344(1):3-10.

18. Brouhard BH. Hypertension in children and adolescents. Cleve Clin J Med 1995;62(1):21-28.

19. Kaplan NM. Dietary aspects of the treatment of hypertension. Annu Rev Public Health 1986;7:503-519.