Student Athlete Cholesterol Screening During Routine Precompetition Examination

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Background. When properly organized and conducted, the preseason physical examination process for scholastic athletes can identify existing medical and musculoskeletal problems as well as provide for age-specific anticipatory guidance. This examination may also present an ideal opportunity to screen for adolescent hyperlipidemia.

Methods. Seven-hundred seventy-seven (777) students, aged 11 to 15 years, from seven junior high schools received fingerstick cholesterol screening during a complete preseason physical examination. Elevated values were verified by repeat examination. Values were compared with previously published national norms for this age group. All students received information on cholesterol, and the parents and pediatrician or family physician of those with confirmed positive tests (higher than 4.8 mmol/L [185 mg/dL]) were notified.

Results. One hundred fourteen (114), or approximately 15%, of the subjects were found to have elevated cholesterol levels. Of the 74 who returned for a second test, 38 (51%) were confirmed as having elevated cholesterol levels. Feedback from parents, principals, and coaches regarding the value of the screening and the associated education was overwhelmingly positive.

Conclusions. In our experience, the precompetition examination provides an opportunity to screen for elevated cholesterol levels and to educate young people about hyperlipidemia.

Key words. Cholesterol, mass screening, sports, health education, pediatrics.
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Family physicians provide most of the primary health care to athletes in West Virginia, and most team physicians are family physicians. The integration of sports medicine into rural family practice has been relatively easy. School sports contests are important events in rural communities; therefore, providing health care to athletes is a valuable service to the community and gives added visibility and credibility to the physician.

Since many young athletes do not receive yearly medical examinations, team physicians who provide sport physicals have a unique opportunity to expand the screening process to include health education and guidance for the adolescent population. A cholesterol screening program that is intended to promote general nutritional awareness and to identify those adolescents at risk for elevated cholesterol levels in adult life is consistent with a philosophy of maximizing the impact of this precompetition examination.

The National Cholesterol Education Program (NCEP) guidelines for screening adults over 20 years of age have been endorsed by a variety of health care professional groups and widely publicized by the media since their initial publication in 1987.[1] Universal cholesterol screening before age 20 years, however, is a source of controversy. The American Academy of Pediatrics endorses cholesterol screening only for children with a strong family history of heart disease or hyperlipidemia. In addition to emphasizing the psychological risk of childhood screening and the potential for inappropriate severe dietary restrictions, the Academy's Committee on Nutrition cited the lack of equipment standardization and the daily variability in cholesterol levels as factors limiting the accuracy of a single test result. A closely supervised adolescent screening process that includes a primary care physician network to follow up elevated results, however, is consistent with the philosophy of the

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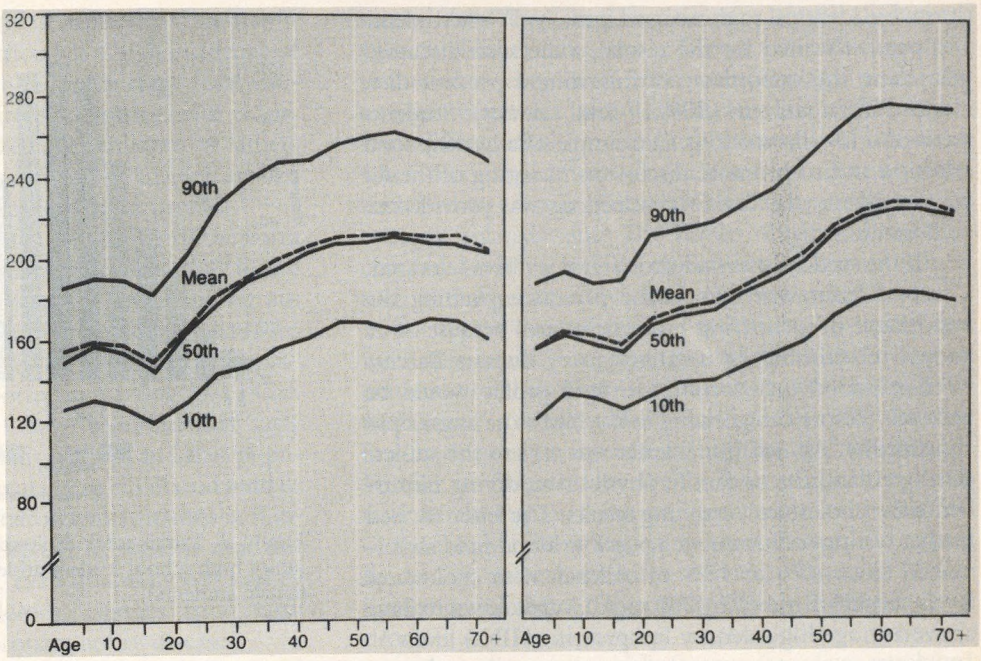

Figure 1. Total cholesterol (mg/dL) means and selected percentiles for white male and female patients on initial screening. From *The Lipid Research Clinics Population Studies Data Book*, Vol 1, p 35.[13]

Academy's recommendations.[2–7] Since studies indicate that cholesterol screening, coupled with physician follow-up and intervention, can have a positive impact in lowering cholesterol levels and the potential risk of cardiovascular disease,[8–10] we elected to have junior high school student athletes from Wood County, West Virginia, receive a total serum cholesterol analysis as part of the sports physical required by their respective schools.

Methods

Seven junior high schools (grades 7, 8, and 9) participated in the preseason physical examination process conducted by the sports medicine department at St Joseph's Hospital during August and October of 1988. The physicals were conducted in a 10-station format. In addition to the standard physical examination, students underwent orthopedic, flexibility, and isokinetic strength testing, as well as body composition assessment. At one station a dietitian discussed with the athletes the relation between nutrition and individual cholesterol values. Each athlete was given nutritional information that included dietary guidelines for the competitive season with emphasis on pregame nutrition and half-time hydration. Additional areas of health education included injury first aid, drug and steroid abuse, body image awareness, tobacco use, and principles of mental imagery for performance enhancement.

At the laboratory station, a dipstick urinalysis, fingerstick hematocrit, and random total cholesterol tests were performed. The Vision Analyzer (Abbott Diagnostics, Abbott Park, Ill) was used for cholesterol determinations. The analyzer was calibrated before the initial testing and was subsequently checked each day against standards. All determinations were within the manufacturer's acceptable range. As with other capillary cholesterol analyzers, a 3% to 5% variation in the true cholesterol level was expected.[11,12] A single laboratory supervisor was present for all determinations to minimize variations in procedure and readings.

The results from the total cholesterol screening test were categorized as being either above or below the 90th percentile for the students' age group as defined in the Lipid Research Clinic's study data.[13] Cholesterol percentile levels vary according to age and sex; however, normal values for individuals in the 11- to 15-year age range are relatively constant compared with those in early adulthood (Figure 1). Those values falling to or below 4.8 mmol/L (185 mg/dL) were considered to be in the acceptable range.[14,15] Each student was informed of his or her cholesterol level at the health education station and was given a two-sided report card that listed the NCEP guidelines for adult values on the backside.

The parents of students whose values were above 4.8 mmol (186 mg/dL) were notified in a letter that also requested permission to perform a second cholesterol test approximately 1 week later. The equipment and procedures used to determine cholesterol levels the second

time were identical to those used initially. While students and parents waited for the results, a dietician discussed with them the importance of following a prudent diet, reduced in fat content (30% of total calories). Students received a low-fat snack as an example of a healthy food selection and to promote discussion. A listing of the fat content of popular fast-food selections was provided to each family.

If the student's second cholesterol level was elevated, a second letter was sent to the parents explaining the importance of identifying high cholesterol because of its known relationship to coronary artery disease. Parents were informed that a complete lipid profile would be necessary before categorizing their child as having a lipid abnormality. An additional letter was sent to the adolescent's pediatrician or family physician notifying him or her of the cholesterol screening results. The letter advised further testing to document a possible blood lipid abnormality, since 10% to 15% of children with cholesterol levels above 5.2 mmol/L (200 mg/dL) are known to have above-average high-density lipoprotein (HDL) levels.[3]

Results

Seven hundred seventy-seven student athletes (454 male and 323 female) with a mean age of 13 years, participated in random capillary blood cholesterol screening. Cholesterol values ranged from 1.7 to 7.1 mmol/L (65 to 274 mg/dL). The mean total cholesterol for this group was 4.0 mmol/L (156 mg/dL) with a standard deviation of .7 (28.37). The distribution of results for both the male and female students approximated a bell-shaped histogram (Figure 2). One hundred fourteen students (14.7%) had a screening total cholesterol level above 4.8 mmol/L (185 mg/dL). Of these, 60 had values greater than 5.2 mmol/L (200 mg/dL), which is the established 95th percentile for this age group.

Results analyzed by sex revealed that 15.4% of boys and 13.6% of girls had cholesterol levels above 4.8 mmol/L (185 mg/dL). A similar average cholesterol level was observed for both groups. The mean for female and male students was 4.1 and 4.0 mmol/L (158 and 155 mg/dL), respectively. These results are in agreement with the accepted mean values for this age group for girls (4.1 mmol/L [160 mg/dL]) and boys (4.1 mmol/L [158 mg/dL]) as determined by the Lipid Research Clinics.[12]

Seventy-four of the 114 students with high initial cholesterol levels returned for a second cholesterol test. Of those retested, 38 students (51%) were found to have cholesterol levels above 4.8 mmol/L (185 mg/dL). A comparison of retest values and corresponding initial screening results revealed that the cholesterol levels of 61 of the 74 students decreased, while those of 12 increased.

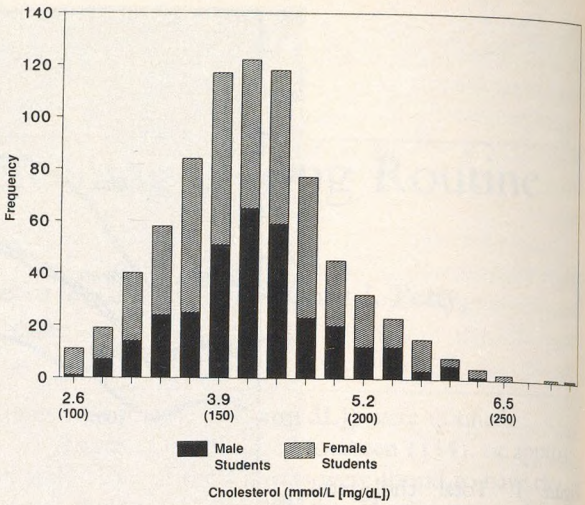

Figure 2. Initial total cholesterol screening results from 777 junior high school student athletes (454 male students and 323 female students).

This change between initial screening and retest values was attributed to both analytic and biologic factors (ie, regression to the mean, expected daily variation). All students with persistent total cholesterol elevations were referred to their private physicians for further testing.

Principals from each of the seven junior high schools participating in the preseason physical examination process were contacted to encourage feedback concerning the cholesterol screening project. All of the schools' principals voiced strong endorsement, and some requested that cholesterol and nutrition information be provided to the entire student body during the coming school year. A telephone survey of coaches and parents also revealed overwhelming support for the addition of cholesterol screening and nutritional education to the precompetition medical examination. Student athletes were generally receptive to the cholesterol screening process, and many were observed comparing results with their peers.

Discussion

Research conducted by the Centers for Disease Control has documented a very high incidence of heart disease in the state of West Virginia.[16] In a state-by-state comparison, West Virginia ranked highest in age-adjusted mortality for diseases of the heart among white male and white female residents aged 35 to 74 years (581 per 100,000 male citizens and 237 per 100,000 female citizens as compared with the national average of 480 and 182, respectively). Coronary artery disease is multifactorial; however, one of the most highly correlated risk

factors is an elevated total cholesterol level. Children in countries in which the population has a high incidence of coronary artery disease have a higher average total cholesterol level than children from countries with a low incidence.[3] It is also recognized that children of fathers who developed coronary artery disease at an early age are at increased risk of having abnormal lipid profiles.[17,18]

Studies have shown that fatty streaking of the aorta begins at an early age.[19] Newman and colleagues[20] found that the extent of these aortic streaks found during autopsies of young people was very strongly related to antemortem levels of both total and low-density lipoprotein (LDL) cholesterol as reported in the Bogalusa Heart Study. Strong and McGill[21] have reported that fatty streaks gradually become fibrous plaques and that populations with extensive fatty streaking in childhood tend to have more extensive raised atherosclerotic lesions in middle age. These studies support the hypothesis that elevated total cholesterol levels, even in childhood, lead to the formation of atherosclerotic plaques from fatty streaks and result in early coronary artery disease.

Since the increased cardiovascular risks associated with abnormal lipid profiles have been confirmed over the past three decades, health care professionals have become more conscious of the value of monitoring cholesterol levels periodically in patients. The Muscatine Study[22] demonstrated a modest degree of tracking for cholesterol levels from childhood into adult life. Sixty-two percent of young adults (age 20 to 30 years) tested who had cholesterol levels above the 90th percentile in childhood were found to have levels above the 75th percentile. Similarly, Orchard and co-workers[23] have reported that 70% of children who were in the upper two quintiles for total cholesterol at 12 years of age remained so at 21 years of age. Based on this knowledge, some investigators have suggested that the total serum cholesterol level should be determined even in preschool age children,[24–26] even though a correlation between treatment of hypercholesterolemia in youth and a reduction in coronary artery disease has not been clearly established.

In Wood County, West Virginia, 15% of junior high school athletes were found to have initial total cholesterol levels above the proposed accepted value (4.8 mmol/L [185 mg/dL]) for their age group. Sixty students (7.7%) had values greater than the 95th percentile (5.2 mmol/L [200 mg/dL]). This finding suggests the need for increased nutritional awareness and cholesterol education in the adolescent population. Parental notification of these elevations, combined with private physician follow-up, allows early detection of adolescents who are at risk for elevated cholesterol levels in adult life.

Before any intervention, a second cholesterol test determination must be performed to confirm a true elevation. Accurate interpretation of a single cholesterol value is difficult since many factors can influence daily variations in cholesterol level including age, sex, cyclic estrogen variations, and recent dietary intake.[27,28] Significant differences in a patient's cholesterol level can occur when blood specimens are collected on separate days; therefore, an average of several values is more meaningful than an isolated value. The results obtained should be compared with a well-controlled set of known values, such as that prepared by the Lipid Research Clinics.

A repeat determination 1 week after an initial elevated test result is an attractive model. Our finding of persistent total cholesterol elevations in only 51% of the reevaluated student athletes verifies the need for follow-up documentation before "high for age" labeling.[7,29] Further investigation by the adolescent's private physician should include a fasting lipid profile, an evaluation of the family history regarding heart disease and hyperlipidemias, an evaluation for secondary causes of hyperlipidemia (diabetes, hypothyroidism, nephrotic syndrome), and an assessment of the patient's behavior-related cardiovascular risk factors (ie, diet, smoking) followed by referral to a dietitian for nutritional counseling as warranted.

Conclusions

The preseason physical examination that is required before students are allowed to participate in sports has traditionally been designed to identify those student athletes who are at increased risk for illness or injury due to preexisting medical or musculoskeletal problems.[30,31] Many students in this age group do not undergo yearly medical examinations by their pediatrician or family practitioner; therefore, physicians conducting yearly sports physical examinations are challenged to take advantage of an excellent opportunity to provide health risk-factors information to the adolescent population.[32,33] Since West Virginia has been noted as having the highest mortality from heart disease of any state, innovative preventive medicine strategies are needed to promote awareness of modifiable heart disease risk factors. In our experience, the precompetition examination, a prerequisite for student sports play,[34] provides an effective arena in which to encourage "heart-healthy" lifestyles.[35–37]

It was encouraging to note that the mean cholesterol level in our population of exercising adolescents was similar to the national average of the same age group. Preliminary results from a 15-county public school cholesterol screening program, which was initiated by the W. K. Kellogg Foundation and coordinated by the West Virginia State Health Department, suggested that cho-

lesterol values for a cross-section of West Virginia adolescents are higher than the national average. Additional research is necessary to compare student athlete cholesterol levels with those of their nonathlete peers; however, it is intriguing to speculate that students' participation in sports may have a positive influence on individual lipid profiles.[38]

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