

High Prevalence of Obesity and High Blood Pressure in Urban Student-Athletes

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Objectives To assess the prevalence of obesity and hypertension-level blood pressures in an urban, athletic adolescent population using preparticipation physical evaluation (PPE) data.

Study design The Athlete Health Organization provides free preparticipation physical evaluations to Philadelphia student-athletes via an annual mass-screening event. From 2009 to 2012, Athlete Health Organization personnel performed PPEs on more than 2700 middle school and high school athletes. The PPE included biometric information, a history, and a physical examination. Medical volunteers measured blood pressures using a manual blood pressure cuff with an aneroid manometer. The data from each PPE were collected and analyzed for prevalence of obesity, overweight, and hypertension-level blood pressure readings.

Results A large percentage of student-athletes were found to be overweight (20%) or obese (24.0%). Many of these athletes also had stage 1 or 2 level blood pressure readings (14.8%), a finding which strongly correlated with elevated body mass index ($P < .00001$).

Conclusions The cardiovascular health of this urban adolescent athletic population is a major concern because their rates of obesity and elevated blood pressure place them at increased risk of cardiovascular complications later in life despite their participation in school athletics. (*J Pediatr* 2016;■■■■-■■■).

Approximately 30 million children and adolescents participate in organized sports in the US. The standard of care is that these athletes undergo preparticipation physical evaluation (PPE) before the season of competition begins.¹ The primary goals of the PPE are to identify athletes at risk for injury, illness, or death. The Athlete Health Organization (AHO) is a nonprofit student health initiative that provides a day of free comprehensive PPEs to Philadelphia high school and middle school student-athletes each year.² The event presents a unique opportunity to evaluate and support an urban student-athlete population. Extraction and analysis of information from PPEs can offer a glimpse into the current health trends in this population. In this study, the data collected during 4 years of AHO PPEs were used to report on the rates of obesity and high blood pressure readings in this adolescent population.

Methods

From 2009 to 2012, AHO personnel ran an annual event to perform station-based PPEs on Philadelphia high school and middle school athletes. Over the 4 years, more than 2700 athletes were seen and evaluated.

At the onset of this study, institutional review board approval was obtained from Thomas Jefferson University. The Pennsylvania Interscholastic Athletic Association's standardized forms that were completed during the PPE sessions were collected, and deidentified data were entered into a filing system. Each form consisted of the athlete's biometrics, personal medical history, family medical history, and comprehensive physical examination. Biometric data included age, sex, grade in school, height, weight, blood pressure, and pulse. The comprehensive physical examination was divided into stations dedicated to vital signs, general medicine, orthopedic, pulmonary, concussion, and cardiovascular examinations. The cardiovascular portion of the examination included a physical examination, electrocardiogram (ECG), and echocardiogram when indicated. Indications for echocardiogram included an abnormal ECG, an abnormal cardiac physical examination, or screening positive on the cardiac questions of the Pennsylvania Interscholastic Athletic Association form. Licensed cardiologists interpreted each ECG using standard ECG reading guidelines for athletes.

AHO	Athlete Health Organization
BMI	Body mass index
CDC	Centers for Disease Control and Prevention
ECG	Electrocardiogram
PPE	Preparticipation physical evaluation

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Medical staff volunteers performed blood pressure measurements on student-athletes in the seated position using manual blood pressure cuffs with aneroid manometers. These medical volunteers included physicians, medical students, and physician assistants. Cuff size was fit for individuals based on current guidelines. All student-athletes with an elevated blood pressure reading were remeasured by a licensed physician using the same method before the reading was finalized. The same method of blood pressure measurement and recording was used each year, however, the medical volunteers changed year to year.

Data collected during the AHO PPE events were analyzed to report on the demographics, weight status, and blood pressure status of the population participating in the events. To analyze the data for information on the obesity and high blood pressure rates in this population, only those athletes with all of the required components from the PPE were counted. As such, if any athlete were missing documentation of height, weight, age, or blood pressure, his/her data were eliminated from analysis as body mass index (BMI) and blood pressure classification could not be determined. Given these criteria, a total of 2678 sets of data were analyzed.

To next categorize an athlete's weight status, the BMI and weight percentile was calculated using guidelines provided by the Centers for Disease Control and Prevention (CDC).³ Blood pressure classification was then determined for each athlete using guidelines provided by the National Heart, Lung and Blood Institute of the National Institutes of Health.⁴ Participants in the AHO PPEs could not formally be diagnosed with hypertension based on only 1 blood pressure reading. However, for the purposes of analysis, blood pressure readings were categorized according to the National Heart, Lung and Blood Institute Fourth Report guidelines. The distinction between stages 1 and 2 level readings remained important as stage 2 level readings were a reason to hold an athlete from participation until further evaluation.

Statistical analysis included calculation of percentages of athletes who fell into each weight and blood pressure category. To determine any statistical link between weight category and blood pressure classification, a χ^2 test of dependence was performed to assess the relationship.

To further characterize the relationship between BMI and blood pressure in this sample, 2 more statistical approaches were used. First, linear regression was used to predict systolic and diastolic blood pressures separately, controlling for sex.

Then, to facilitate interpretation of the regression coefficients and for predicting category membership in a "non-normotensive" category, all blood pressure values were converted to a categorical variable where 1 was "non-normotensive" (prehypertensive-, stage 1- and stage 2 level) and 0 was "normotensive." Logistic regression was used to characterize this relationship.

Results

Over the 4-year study period, 2678 athletes ranging in age from 10 to 20 years old had complete PPEs. Of the total participants, 69% were male. Race and ethnicity data was only collected in 2012, which revealed that 71% of participants self-identified as African American, 16% as Caucasian, 7% as Asian, 5% as Hispanic, and 1% as other (Table I). There were no major demographic shifts in schools that participated in the AHO event so, although it cannot be guaranteed, the race and ethnicity percentages would have likely been similar in other years.

A large number of student-athletes were overweight or obese based on BMI calculations. In 2009, 24% of participants were obese with another 23% categorized as overweight; by 2012, the percentage of obese participants remained similar at 22.5% and overweight at 19.2% (Table I).

Beyond the BMI findings, a large number of athletes were found to have abnormally elevated blood pressures. In each

Table I. Demographics by year

	2009	2010	2011	2012
Total, N	758	561	658	701
Age, mean $\pm$ SD	15.0 $\pm$ 1.9 y	15.8 $\pm$ 1.2 y	15.7 $\pm$ 1.3 y	15.7 $\pm$ 1.2 y
Range	10-19 y	11-19 y	11-20 y	12-20 y
Sex				
Female	273 (36%)	157 (28%)	213 (32%)	186 (27%)
Male	485 (64%)	404 (72%)	445 (68%)	515 (73%)
Race/ethnicity				
African American				500 (71%)
Caucasian				114 (16%)
Asian				48 (7%)
Hispanic				35 (5%)
Other				4 (1%)
Weight status				
Obese	185 (24%)	135 (24%)	167 (25.4%)	158 (22.5%)
Overweight	175 (23%)	105 (18.7%)	131 (20%)	135 (19.2%)
Normal weight	392 (52%)	319 (57%)	356 (54%)	395 (56.3%)
Underweight	6 (1%)	2 (0.3%)	4 (0.6%)	13 (2%)
Blood pressure				
Prehypertension level	112 (15%)	60 (10.6%)	96 (14.6%)	90 (12.8%)
Stage 1 level	107 (14%)	71 (12.7%)	108 (16.4%)	77 (11%)
Stage 2 level	13 (1.7%)	7 (1.2%)	3 (0.5%)	11 (1.6%)

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