ORIGINAL REPORTS: CARDIOVASCULAR DISEASE AND RISK FACTORS

IMPACT OF AN URBAN COMMUNITY HYPERTENSION SCREENING PROGRAM ON PARTICIPATING HIGH SCHOOL STUDENTS

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Background: Hypertension is increasingly being recognized as a major health problem in adolescents, particularly those of minority ethnicity. We assessed elevated blood pressure (BP) prevalence and predictors, as well as the impact of participating in a community hypertension screening program among high school students in an urban school district.

Methods: In 2008, 603 predominantly Hispanic students from nine Los Angeles high schools in predominantly Hispanic communities were recruited and trained to screen for high BP (≥140/90 mm Hg) in their communities. As part of the program, students measured one another's blood pressure and completed a pre- and post-assessment (2 weeks later), which measured hypertension risk factors, knowledge, interest in health careers, and empowerment. A multivariable analysis using logistic regression evaluated the association between several factors and presence of elevated BP.

Results: Eighty-two (14%) of students had BP readings in the hypertensive range, with 78 (95%) of whom had no prior diagnosis of hypertension. Being overweight (OR 2.85, 95% CI = 1.31–6.20) or obese (OR 8.90, 95% CI = 3.83–20.69) were the only factors independently associated with elevated BP. Significant increases were observed in student knowledge regarding hypertension and interest pursuing three of five health professions ($P<.05$), but no significant change in student empowerment was noted.

Conclusions: One in six urban district high school students screened in this study had presence of elevated BP, the overwhelming majority of whom had no prior hypertension diagnosis. Program participation slightly boosted health career interest and hypertension knowledge. Involvement of urban high school students in self-screening hypertension programs may be of benefit. (*Ethn Dis.* 2011; 21:68–73)

Key Words: Community, Students, High School, Blood Pressure, Outcomes, Hypertension, Screening, Risk Factors, Minorities, Los Angeles, Adolescent, Obesity, Hispanic

INTRODUCTION

While hypertension has long been recognized as a major health concern in adults, the condition is now recognized as common in children and adolescents, as well. Studies in the United States have found the prevalence of hypertension in those aged <18 years to be between 3% and 5%.[1–3] While childhood hypertension can be caused by an underlying health condition, it is also associated with a family history of hypertension and obesity.[4] Indeed, compelling evidence exists linking the increase in childhood hypertension to the ongoing obesity epidemic in children.[2,3,5–7] Childhood hypertension is of particular concern as it is associated with hypertension and its untoward sequela later in adulthood.[8] Alarmingly, some of the early signs of cardiovascular morbidity resulting from hypertension are becoming increasingly apparent in adolescence.[9]

Not unlike the higher prevalence of undiagnosed or poorly controlled hypertension in adult minority patients compared to non-Hispanic Whites, it is conceivable that children/adolescents of ethnic minority extraction may also be underdiagnosed and treated given their exposure to the same environmental influences as their parents. The Los Angeles Unified School District (LAUSD) is the second largest school district in the nation, with nearly 700,000 students.[10] The majority of students in the LAUSD are Hispanic (73%), followed by African-American (11%), White (9%), and Asian (4%). In 2008, a hypertension screening program targeting high school students in the LAUSD, as well as adults in the surrounding communities, was conducted. This program followed up a 2005 study that investigated the feasibility of using high school students to carry out a hypertension screening and education program in their communities.[11] The 2005 study was highly successful, with students screening over 5000 community members and finding 3% with previously undiagnosed hypertension. The 2008 study replicated the community screening program of the 2005 study, and expanded on it by investigating its impact on the students themselves. We hypothesized that given the relatively high rate of undiagnosed

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We hypothesized that given the relatively high rate of undiagnosed hypertension among adults in the community, that several of the students may also have undiagnosed hypertension.

hypertension among adults in the community, that several of the students may also have undiagnosed hypertension. Furthermore, we expected that being trained for and then carrying out the community screening program could have a positive impact on student knowledge related to hypertension, interest in pursuing a career in health, and feelings of empowerment.

METHODS

A total of nine high schools participated in the program, including a school for the deaf and hard of hearing. These schools served a largely low-income student population, with 54% to 89% of students eligible for free or reduced price lunch.[12] Within each school, one or more health, political science, or economics classes participated.

Students were eligible to participate if they were in the 10th grade or higher, if they signed an assent form, and if they returned a consent form signed by a parent. Students over 18 could give their own consent. As compensation for participating in the community screening program and student study, students received classroom credit, a certificate of participation that could be added to their college application portfolio, and a program branded t-shirt. Students who did not participate were given an alternative assignment.

Student participants received training for completing the community screening by the LAUSD Nursing Services over two class periods. The first day of training consisted of a basic cardiovascular health curriculum, including risk factors for and consequences of untreated hypertension. During the second class period, nurses trained students to use digital blood pressure (BP) monitors (Omron HEM-629N2, Bannockburn, Illinois) and explained how to recruit and screen community members.

Students practiced using the BP monitors on one another and then each student measured and recorded the BP of his or her partner using the appropriately sized cuff. To facilitate a standardized yet practical approach to BP determination, a single BP measurement was obtained after ensuring that the partner was at seated rest for at least ten minutes with feet planted on the floor.[13] Students having BP in the pre-hypertensive range or higher (ie, ≥120/80) were referred to their school nurse for follow-up.

A pre- and post-survey instrument was developed to measure student demographics, hypertension risk factors, and relevant outcomes. The pre-assessment was administered to students prior to their receiving the cardiovascular health curriculum on the first day of training. The pre-assessment measured student age, sex, race/ethnicity, height, weight, level of exercise, and salt consumption. Students were also asked to report any family history of hypertension, previous diagnosis of hypertension, and how long it had been since their BP was last measured. In addition, students were asked a series of scaled questions about their likelihood of pursuing a career in five health fields and given ten true/false questions to assess their knowledge regarding hypertension. Lastly, a previously validated empowerment scale[14] was given. The post-assessment was administered two weeks after the pre-assessment, once students had finished conducting the community screening program. The post-assessment contained identical questions regarding career interest, knowledge, and empowerment. All answers on the pre- and post-assessments were by self-report.

Data from these surveys were collected in two waves; from April 12 to May 8, 2008 and from September 22 to November 18, 2008. A total of 630 students completed the pre-assessment. Of these, 567 students also completed the post-assessment (90%). Student hypertension was calculated using the sex, height, and weight percentiles from the *Fourth Report on Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents*.[4] A BP reading in the hypertensive range was defined as a systolic and/or diastolic BP ≥95th percentile for height, sex, and age. A BP reading in the pre-hypertensive range was defined as systolic and/or diastolic BP ≥90th percentile or ≥120/80 mm Hg, but below the cut-off for hypertension. For bivariate and multivariate data analysis, pre-hypertensive BP readings were combined with normal readings and only hypertensive BP readings were considered to be elevated BP. Eleven students were excluded from analysis of elevated BP due to missing information on height, weight, and/or age.

Body mass index (BMI) was adjusted for sex and age according to the growth chart data from the Centers for Disease Control and Prevention.[15] Students with a BMI ≥95th percentile were categorized as obese, students ≥85th percentile, but <95th percentile were categorized as overweight, students ≥5th percentile, but <85th percentile were categorized as healthy weight, and students <5th percentile were considered underweight. Because there were only seven students in our sample who were categorized as being underweight, they were excluded from the logistic regression analysis. The study was approved by the LAUSD Program Evaluation Research Branch.

Table 1. Characteristics of Los Angeles Unified School District high school students involved in a community hypertension screening project (*n*=603)

Variable	
Age	Range: 14–21 years; Median: 17 years
Sex	
Male	35%
Female	65%
Ethnicity	
African-American	11%
Asian	7%
Hispanic	75%
White	4%
Other	4%
Weight status	
Underweight	1%
Healthy weight	63%
Overweight	24%
Obese	12%
Blood pressure	
Normal	60%
Pre-hypertensive	27%
Hypertensive	14%

Statistical Analyses

Chi-square tests were used to determine whether rates of elevated BP readings varied by sex, ethnicity, and several risk factors. McNemar's tests were used to investigate differences in knowledge scores from the pre- to post-assessment. Wilcoxon signed-rank tests were run to detect differences in career interest from the pre- to the post-assessment. A paired samples *t* test was used to detect a difference between the mean scale score for student empowerment. A multivariate logistic regression was conducted to determine which factors were associated with having elevated BP. Statistical analyses were performed using SPSS version 11.0 (SPSS, Inc., Chicago, IL) with statistical significance predetermined to be at $P<.05$.

RESULTS

Students in the sample were primarily Hispanic (75%) and female (65%) (Table 1). Ethnic distribution of our sample was similar to that of the student population of the LAUSD as a whole, with Whites slightly under-represented and Asians slightly over-represented in our sample.[10] Nearly one-quarter of students were classified as overweight, and 12% were obese. Fourteen percent of students had a BP reading in the hypertensive range, and 27% of students had a reading in the pre-hypertensive range.

At 14%, Hispanic students were most likely to have a BP reading in the hypertensive range (Table 2). Hispanic students were also least likely to fall in the healthy weight category, with 41% either overweight or obese. Bivariate analyses were conducted to explore relationships between elevated BP and sex, ethnicity, weight category, exercise level, salt intake, and family history of hypertension. Of these, significant associations were found only for sex (chi-square= 6.78 [df=1]; $P=.012$) and weight category (chi-square= 29.93 [df=2]; $P<.0001$).

The majority of students (79%) reported having their BP measured in the last year. Three percent of students had been told previously by a doctor or other health professional that they had hypertension. Of the 82 students in our sample with an elevated BP reading, four students reported a previous diagnosis of hypertension, resulting in 78 potentially new cases of hypertension in our study.

After controlling for age, sex, ethnicity, weight status, and family history of hypertension, only weight status was significantly associated with receiving a BP measurement in the hypertensive range (Table 3). Students categorized as overweight were about 3 times as likely to receive a BP measurement in the hypertensive range compared to students with healthy weight. Similarly, students categorized as obese were about 9 times as likely to a receive BP measurement in the hypertensive range compared to students with healthy weight.

Hypertension-Related Knowledge

Overall student scores on knowledge questions improved from the pre- to the post-assessment. The mean percentage of students who answered each question correctly on the pre-assessment ranged from 53% to 94% and on the post-assessment ranged from 66% to 95%. There were positive differences for nine of ten questions; seven of these differences were statistically significant. Students had a lower post-assessment score for one question regarding the relationship between hypertension and kidney disease, but the difference was not significant.

Interest in Pursuing a Career in Select Health Fields

Median scale scores for the likelihood of pursuing all five careers fell in the "likely" to "neutral" range, on both the pre- and post-assessment. There was a small but significant increase in interest in pursuing a career as a nurse ($Z=-2.49$, $P=.013$), a medical assistant ($Z=-2.16$, $P=.031$) and emergency medical technician ($Z=-2.52$, $P=.012$). No significant difference was observed in likelihood of pursuing a career as a medical doctor ($Z=-.742$, $P=.458$) or dentist ($Z=-.619$, $P=.536$).

Empowerment

No significant change was observed in the mean empowerment scale scores from the pre- to the post-assessment ($t(556) = -1.47$, $P=.142$). The median score for four items on the pre-assessment was "agree" and for one was "neutral"; this was identical on the post-assessment.

DISCUSSION

In this study, we found that nearly one of every six students screened in this urban school district had an elevated BP requiring referral to their school nurse

Table 2. Prevalence of pre-hypertensive and hypertensive BP reading by sex, Ethnicity, and weight status among Los Angeles Unified School District high school students involved in a community hypertension screening project

Variable	Normal	Pre-hypertensive	Hypertensive
Sex			
Male (n=210)	37%	44%	19%
Female (n=393)	72%	17%	11%
Ethnicity			
African-American (n=65)	59%	31%	11%
Asian (n=41)	68%	20%	12%
Hispanic (n=441)	60%	25%	14%
White (n=24)	46%	42%	13%
Other (n=22)	55%	36%	9%
Weight status			
Underweight (n=7)	86%	0%	14%
Healthy weight (n=358)	70%	23%	8%
Overweight (n=135)	54%	31%	15%
Obese (n=67)	28%	40%	31%

for follow-up BP measurement and possible treatment. While the majority of students in this study reported having their BP taken within a year of our study, we detected elevated BP in 78 students with no previous diagnosis of hypertension (95% of those with elevated BP). An additional 160 (27%) of students had a BP reading at the pre-hypertensive level, while 203 (36%) of students were found to be overweight or obese.

These data build upon a prior research finding that both hypertension and overweight are pervasive among Los Angeles school children.[5] As in the previous study, we found a strong correlation between elevated BP and excess weight, with obese students nearly 9 times as likely, and overweight students nearly 3 times as likely, as healthy weight students to have an elevated BP reading, even after adjusting for known confounders (ie, ethnicity, sex, and family history of hypertension), findings that are consistent with the results of other published research.[2,3,5,9] Of note, Hispanic students were the most likely to have an elevated BP reading, probably because they were also more likely to be overweight or obese.

Table 3. Logistic regression predicting elevated BP among Los Angeles Unified School District high school students involved in a community hypertension screening project

Variable	OR	95% Confidence Interval	
		Lower	Upper
Age	.883	.622	1.251
Sex			
Female	Ref		
Male	1.606	.825	3.126
Ethnicity			
White	Ref		
African-American	1.473	.137	15.780
Asian	4.107	.391	43.177
Hispanic	2.448	.288	20.819
Other	2.869	.212	38.816
Family history of hypertension			
No	Ref		
Yes	1.009	.418	2.434
Weight status			
Healthy weight	Ref		
Overweight	2.845	1.307	6.190
Obese	8.902	3.830	20.689

In this study, we found that nearly one of every six students screened in this urban school district had an elevated BP requiring referral to their school nurse for follow-up BP measurement and possible treatment.

We also investigated various effects on students after carrying out the hypertension screening program in their communities, and found modest benefits. Student participants had an overall gain in knowledge related to hypertension and cardiovascular health, and also showed a small increased interest in pursuing three of five health professions. It is noteworthy that the students did not seem to have developed a greater interest in becoming physicians or dentists and the reasons for this are not immediately clear. It is possible that not enough role models of similar ethnicity are available within and beyond the community to reinforce such aspirations or the students were inspired by the many nurses and allied medical personnel involved in executing this study (there were no physicians or dentists involved in the actual execution). We also hypothesized that the act

of carrying out this program would have a positive effect on empowerment among students, however, no such correlation was found. This lack of an effect may have been due to the fact that students had a relatively high level of empowerment on the scale to begin with, or perhaps more sustained activities are required to impact empowerment.

This study has limitations. First, the sample was not randomly selected, and therefore results cannot be readily generalized to the broader population of high school students in the LAUSD. Second, all data were collected from students by self-report, with the exception of BP measurement. This could result in recall bias, and might also result in a tendency to report more socially-desirable answers. A third limitation was that due to limited classroom time allocated to this program, for practical purposes only a single BP measurement could be taken. Recommendations for classifying hypertension in children and adolescents state that an elevated BP must be confirmed on at least three occasions.[4] Therefore, we could not categorically confirm whether students in our sample actually have hypertension, or simply had a single elevated BP reading. A similar study found 19% of children with a BP reading in the hypertensive range on the first measurement, but just 4.5% of students were determined to have hypertension by the third measurement.[3] It is reasonable to expect that hypertensive BP readings in our study population would be similarly reduced by the third measurement. However, evidence exists that even a single BP measurement can be predictive of future hypertension. A study of over 8,000 adolescents with a single BP measurement in the hypertensive or pre-hypertensive range found that 43% of girls and 68% of boys had either hypertension or pre-hypertension at a 2-year follow-up.[16] A strong relationship between elevated BP and obesity and overweight in our study also lends credibility to our findings.

Despite the aforementioned limitations, the high levels of elevated BP found in this study suggest that routine screening of students in the LAUSD, and possibly other Hispanic-rich urban school districts around the country for hypertension, may be warranted. In light of research findings indicating that adolescent hypertension can lead to cardiovascular disease precursors [9] and its association with hypertension later in adulthood,[8] opportunities for early screening are needed to identify individuals at risk and avert future cases of cardiovascular disease. Interventions that promote physical activity and healthy eating among students are needed in Los Angeles to reduce the high rates of obesity and overweight, as well as rates of hypertension. This may be particularly important for Hispanic students, who were most likely to be overweight and also most likely to have a BP reading in the hypertensive range in our study.

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