A pilot study of the feasibility of heart screening for sudden cardiac arrest in healthy children

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Background In children, sudden cardiac arrest (SCA) is associated with structural and electrical cardiac abnormalities. No studies have systematically screened healthy school children in the United States for conditions leading to SCA to identify those at risk.

Methods From June 2006 to June 2007, we screened 400 healthy 5- to 19-year-olds (11.8 ± 3.9 years) in clinical offices at The Children's Hospital of Philadelphia using a medical and family history questionnaire, weight, height, blood pressure, heart rate, cardiac examination, electrocardiogram (ECG), and echocardiogram (ECHO). Our goals were to determine the feasibility of adding an ECG to history and physical examination and to identify a methodology to be used in a larger multicenter study. A secondary objective was to compare identification of cardiovascular abnormalities by history and physical examination, ECG, and ECHO.

Results Previously undiagnosed cardiac abnormalities were found in 23 subjects (5.8%); an additional 20 (5%) had hypertension. Potentially serious cardiac conditions were identified in 10 subjects (2.5%); 7 were suspected or identified by ECG and 3 more only by ECHO. Only 1 of the 10 had symptoms (previously dismissed); none had a positive family history.

Conclusions It is feasible to screen for conditions associated with SCA in healthy children by adding ECG to history and physical examination. In this nongeneralizable sample, ECG identified more cases compared to history and physical examination alone, with further augmentation from ECHOs. Improvements in ECG and echocardiographic normative standards, representing age, gender, race, and ethnicity, are needed to increase the efficacy of screening in a young population. (Am Heart J 2011;0:1-7.e3.)

Conditions associated with sudden cardiac arrest (SCA) in children include hypertrophic cardiomyopathy (HCM), arrhythmogenic right ventricular cardiomyopathy, coronary artery anomalies, Marfan syndrome, congenital heart defects, long QT syndrome (LQTS), and other primary electrical abnormalities such as the Brugada and Wolff-Parkinson-White (WPW) syndromes. These conditions result in an undetermined number of childhood deaths yearly in the United States, estimated from 100 to >1000.[1-3] In countries that include electrocardiographic screening in preparticipation evaluations, the electrocardiogram (ECG) is more sensitive in identifying those at risk for SCA than history or physical examination alone.[4] Reports suggest that the ECG can help identify youth with undiagnosed conditions predisposing to SCA with subsequent prevention of SCA and death.[5]

No studies have systematically screened healthy school-aged children in the United States to identify those with conditions that may result in SCA. The best method to identify those children at risk for SCA and the best population to target through primary screening is currently controversial.[6-8]

Current screening recommendations

In Europe, a common screening program based on the 12-lead ECG in addition to the focused history and physical examination has been recommended.[9] Under the American Heart Association guidelines, the United States only recommends screening competitive athletes using history and physical examination but not an ECG.[10] Data are needed to evaluate the efficacy of the current US screening compared to ECG and/or echocardiographic screening.

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doi:10.1016/j.ahj.2011.01.022

Rationale for heart screening in healthy children

Mass cardiovascular screening of school children in Japan has been mandatory since 1973; reports indicate that screening including an ECG has a greater sensitivity compared to history and physical examination alone.[11] Studies from Italy have shown that the ECG is 3 times more likely to identify those at risk than the history and physical examination alone, with a sensitivity of 98.8%.[12,13] Recent screening in the United Kingdom and Netherlands showed that most abnormalities identified would have been missed without an ECG, leading these authors to suggest that a 12-lead ECG is necessary when screening for conditions that cause SCA.[14,15] In the largest ECG screening study in the United States of 5,615 high school athletes, sensitivity of the ECG was 70% versus 6% for history and physical examination.[16] A recent report of 510 college athletes indicated that screening with ECG, in addition to history and physical examination, improved the overall sensitivity of screening to 90.9%, with a negative predictive value of 99.8%. Most serious conditions were identified by ECG but not by history and physical examination; the study did find 16% false positives from the ECG, leading the authors to suggest that the current ECG abnormality criteria need to be revised.[17] In 2006, Corrado et al[5] reported that the incidence of SCA in athletes had significantly decreased by 89% for a 25-year period of ECG-based screening of athletes. There are no US studies to confirm or refute this finding. Due to the low prevalence of SCA in the young, it has been estimated that such a study to determine the efficacy of ECG screening in the United States to prevent SCA and death would require the evaluation of several million person-years.[18]

We initiated a pilot study to evaluate the feasibility of adding an ECG to cardiac screening of healthy school-aged children to identify those with conditions that are associated with SCA as well as to develop a methodology to study screening in a large population of youth. Our objective was not to determine the incidence of conditions associated with SCA in this small sample of healthy children or to determine the ability of ECG screening to prevent SCA, as a much larger sample would be required.

Methods

Study group

The institutional review board of The Children's Hospital of Philadelphia (CHOP) approved our pilot Heart Health Screening Study. Eligible subjects were 5- to 19-year-olds with no known cardiac conditions or previous cardiac evaluations. Parental written consent was obtained with assent in children >12 years. Subjects were recruited from CHOP-affiliated community pediatric practices. This sampling was considered acceptable because this study was not intended to represent a generalizable population or to determine incidence of specific conditions. Our major objective was to determine feasibility of adding an ECG to heart screening of children and adolescents. As such, the goal was set at screening 400 children, as this could be reasonably completed in a year. The pediatricians were specifically instructed only to refer children they considered healthy and without any heart condition and to refer those with suspected cardiac conditions for a separate clinical cardiology consultation. The Heart Health Screening Study Research Nurse Coordinator called subjects (parents) who agreed to be contacted, described the research protocol, and arranged an appointment for a study visit.

Study design

From June 2006 to June 2007, we screened 400 healthy 5- to 19-year-olds with a personal medical and family history questionnaire, weight, height, blood pressure, cardiac examination, ECG, and echocardiogram (ECHO). The questionnaire (see online Appendix) consisting of standard cardiac-focused questions used in preparticipation athletic screenings and a detailed family history was sent to the family to be returned at the appointment. Cardiac examinations were performed in the CHOP clinical offices.

The Research Nurse Coordinator obtained height, weight, blood pressure, and heart rate measurements. A supine resting 15-lead ECG was obtained and interpreted by a CHOP pediatric cardiologist using Davignon's normative values for ages through 16 years.[19] For subjects >16 years, Corrado norms were used.[9,12] QTc intervals were calculated using the Bazett formula, recording the longest QTc measured, generally in leads II, V_5, or V_6.

Echocardiograms were obtained by pediatric echocardiographic technicians using standard methodology for a clinical ECHO and were interpreted by pediatric echocardiologists without knowledge of the ECG, history, or physical examination. All echocardiographic abnormalities were noted, not only the findings suggestive of HCM. The ECHO served to identify false positives and false negatives for structural and functional cardiac conditions when compared to the ECG. A complete cardiovascular examination was performed. Thirty to 60 minutes were required to complete each visit, with all protocol studies obtained at the single study visit. Results of the screening tests were provided at the end of the initial visit and subsequently mailed to parents and primary physicians. Those with hypertension were referred to the primary physician for confirmation and treatment. Additional tests were performed as clinically indicated and included exercise stress tests (to clarify borderline QTc readings), tilt table tests (for syncope that appeared to be vasodepressor), genetic tests (for LQTS), magnetic resonance imaging (for arrhythmogenic right ventricular cardiomyopathy), and 24-hour ambulatory ECG monitoring (for LQTS and complex ventricular arrhythmias on standard screening ECG).

Additional clinically indicated tests were covered by insurance, with all children in the study covered by private or public insurance. Cost-effectiveness evaluations were beyond the scope of this particular research protocol. The authors are solely responsible for the design and conduct of this study, all study analyses, and the drafting and editing of the paper and its final content.

Table I. Study population characteristics (N = 400)

Age (y)	11.8 ± 3.98
Gender, n (%)	
Male	213 (53.3)
Female	187 (46.8)
Race/ethnicity, n (%)	
African American	39 (9.8)
White	348 (87)
Asian	9 (2.3)
>1 race	4 (1)
Hispanic	4 (1)

Statistical analysis

Categorical data are presented as frequency count (percentage) and continuous data as means (SDs). Two sample t tests were used to compare echocardiographic z scores between subjects with normal and abnormal ECG measurements for left ventricular hypertrophy (LVH). z Scores are used in pediatric ECHOs to normalize measurements to body surface area changes associated with normal growth and development. Screening test statistics, including sensitivity, specificity, and positive and negative predictive values, were calculated using 2 × 2 contingency tables based on the ability of each screening technique to identify subjects with abnormalities. We used SAS (SAS 9.2, SAS Institute Inc, Cary, NC) for all analyses and considered $P < .05$ to be statistically significant.

Results

Table I shows the age, gender, and racial distributions of the study population of 400 children and adolescents. Previously undiagnosed cardiac abnormalities were found in 23 subjects (5.8%); an additional 20 (5%) had hypertension, defined for this study as 2 blood pressures >95th percentile. Potentially serious conditions were identified in 10 subjects (2.5%). Electrocardiogram identified prolonged QT interval/LQTS (2), WPW anomaly (1), complex ventricular ectopy (2), ostium primum atrial septal defect (ASD) (1), and left ventricular dysfunction (1), with the latter 2 confirmed by ECHOs. Echocardiograms alone identified dilated aorta (2) and anomalous left circumflex coronary artery (1).

Only one of the 10 had symptoms; none had a positive family history. Although one had been known to have prior syncope, this had previously been dismissed as vasovagal (possibly correctly). One, with a primum ASD, was suspected from the cardiologist's physical examination (also suggested by the ECG and confirmed by ECHO). Six abnormal conditions were identified or suspected from the ECG alone, and one more was first suspected from ECG, then by physical examination, and subsequently confirmed by ECHO. Of the 5 identified by ECHO, 3 were only by ECHO. The ECHO obviously could not identify the electrical conditions, thus artificially lowering its sensitivity. The ECG alone had the highest sensitivity of all methods to identify true serious abnormalities as well as higher specificity than history and physical examination (Table II). The CIs of the sensitivity are quite wide. Therefore, although the sensitivity and specificity of the ECG suggest improved identification, we recognize that there is low power to demonstrate the superiority of ECG and ECHO over the history and physical examination in this small sample.

Table II. Comparison of screening methods of ECG, ECHO, history, and physical examination

	Sensitivity (95% CI)	Specificity (95% CI)
ECG	0.7 (0.348-0.993)	0.931 (0.901-0.954)
ECHO	0.5 (0.187-0.813)	1 (0.991-1)
History and physical examination	0.2 (0.025-0.556)	0.423 (0.374-0.474)

Symptoms of syncope (3%) even during exercise (0.5%), palpitations (7%), chest pain (3%), and shortness of breath (10%) were common in this group. Only the one with syncope, who also had a prolonged QT interval, was considered to have a true-positive symptom, and all others were false positives. The physical examination in youth is confounded by the high prevalence of innocent heart murmurs (36%). Only one of the serious conditions, the primum ASD, might have been identified by the physical examination.

Other previously undiagnosed less serious forms of heart disease were found in 13 children (3.3%), including mild atrioventricular and semilunar valve regurgitation and a small patent ductus arteriosus. Overall, additional testing to clarify diagnosis was performed in 24 subjects (6%). All subjects with medical conditions were referred for appropriate treatment and follow-up, as clinically indicated. This included surgery (ASD), medications, and observation.

Analysis of ECG abnormalities

Detailed ECG findings are shown in Table III and include *benign normal variants*, defined as common ECG differences that we considered commonly present and clinically insignificant. The most common of these are sinus arrhythmia (57%), low right atrial rhythms (5.5%), isolated right ventricular conduction delays (13.3%), nonspecific ST-T wave changes (26.3%), and early repolarization (9.3%). With regard to ECG abnormalities, 7 were true positives for serious cardiovascular conditions. A summary of ECG findings is shown in Table IV.

Left ventricular hypertrophy. Of the 17 subjects (4.3%) considered to have "definite LVH" by ECG (defined as 2-3 LVH criteria >98th percentile), 10 (2.5%) had ≥3 LVH criteria including both precordial and limb lead measurements >98th percentile, and 7 (1.8%) had 2 abnormal lead measurements >98th percentile. Most ECG findings for LVH were only slightly over the upper limits of normal using Davignon criteria.

Table III. ECG normal variant and abnormal findings on 15-lead ECG

Normal variant findings	n (%)	Abnormal findings*	n (%)
Rhythm		Rhythm	
Sinus arrhythmia	227 (57)	Complex VA, NS-VT	2 (0.5)
Sinus bradycardia	55 (14)		
Sinus tachycardia	5 (1.3)		
Ectopic low right atrial rhythm	22 (5.5)		
Other (PACs, PVCs, JR, LAR)	15 (3.8)		
Conduction		Conduction	
1° AV Block	8 (2)	WPW	1 (0.3)
2° AV Block	2 (0.5)		
RVCD	53 (13.3)		
IVCD	13 (3.3)		
Axis		Axis	
RAD <110°	2 (0.5)	RAD ≥110°	2 (0.5)
LAD <–30°	3 (0.8)	LAD ≥–30°	3 (0.8)
Waveform		Waveform	
RAE	8 (2)		
Possible LVH	15 (3.8)	LVH	17 (4.3)
Possible RVH	8 (2)	RVH	3 (0.8)
Repolarization		Repolarization	
Early repolarization	37 (9.3)	QTc intervals 0.46-0.49 s	9 (2.3)
Nonspecific ST-segment elevation	105 (26.3)	LQTS	2 (0.5)
Prominent U waves	74 (18.5)	ST-segment elevation, abnormal T wave	1 (0.3)

*Some subjects have >1 abnormality. *PAC*, Premature atrial contraction; *PVC*, premature ventricular contraction; *JR*, junctional rhythm; *LAR*, left atrial rhythm; *AV*, atrioventricular; *RVCD*, right ventricular conduction delay; *IVCD*, intraventricular conduction delay; *RAD*, right axis deviation; *LAD*, left axis deviation; *RAE*, right atrial enlargement; *RVH*, right ventricular hypertrophy; *NS-VT*, nonsustained ventricular tachycardia; *VA*, ventricular arrhythmia; WPW, Wolff-Parkinson-White.

Table IV. Summary of ECG findings

Characteristic	n	%
Total subjects with ECG abnormalities	31	7.8
False positive: waveform/axis/arrhythmia	23	5.8
True-positive ECGs for serious conditions	7	1.8
QT abnormalities	11	3
False positives	8	2
True positives	2	0.5
Borderline	1	0.25

Only 9 subjects (2.3%) had R wave amplitudes of ≥30 mm in RV_6, and only 4 had both RV_6 and at least 1 limb lead ≥30 mm.

QTc intervals and borderline abnormalities. Normal QTc intervals up to 0.459 seconds were seen in 389 subjects (97.2%). Eleven (2.8%) had elevated or borderline QTc intervals of 0.46 to 0.490 seconds. Eight were false positives that normalized on repeat ECG and exercise stress testing. Exercise stress testing and clinical information were used to define a diagnosis of LQTS in 2 subjects (0.5%), whereas 1 remained in a borderline (0.458 seconds) range.

Table V. ECG and ECHO associations

ECHO value with significant ECG association	Associated ECG diagnosis or measurement	P
LV mass	Definite LVH by ECG	.036
LV mass *z* score	QV6	.004
	RV_6 + QV6	<.001
	RII + RV_6 + QV6	.009
LV diastolic free wall thickness *z* score	RII + RV_6	.04
	RII + RV_6 + QV6	.03
LV diastolic septal thickness *z* score	RV_6 + QV6	.03
	RII + RV_6 + QV6	.02

LV, Left ventricular.

Electrographic associations by age, race or ethnicity, and gender

Significant differences were noted in heart rate, QRS and PR intervals, and T wave axis by age ($P < .0001$). RV_5, RV_6, and SV3 + RaVL were significantly different by gender ($P < .02$). Interestingly, T wave axis was significantly different by race ($P = .02$). The sample size for some races/ethnicities was too small to determine other specific differences.

Analysis of echocardiographic abnormalities

Echocardiograms identified 5 important abnormalities (3 by ECHOs alone, with normal ECGs, and 2 appreciated first by ECG). Left ventricular diastolic and systolic dimensions and *z* scores were associated significantly with age, gender, and race ($P < .001$). These findings suggest that there are racial and gender differences in these values that are not represented by the current *z* scores, which are adjusted only for age.

Electrocardiographic and echocardiographic associations

Although actual LVH was not seen on ECHOs, we statistically assessed associations of positive LVH diagnostic criteria on ECG with echocardiographic measurements. The significant associations of echocardiographic values and ECG criteria for LVH are shown in Table V.

Discussion

This study reports a pilot cardiac screening experience in healthy school-aged children. We found that it was feasible to use the ECG to screen school-aged children to improve the likelihood of finding cardiovascular

abnormalities. The ECHO further enhanced the identification of abnormalities. In our study, the ECG outperformed the history and physical examination and found previously unidentified potentially serious abnormalities in children that would not have been identified by history and physical examination alone. In our small sample, the ECG was over 3 times more likely than the history and physical examination to identify true abnormalities. These children were not all high school athletes, and most would not have undergone athletic cardiac screening at this time. Furthermore, these children all had regular history and physical examinations by their primary care physicians without identification of their conditions. The ECG added <10 minutes to the evaluation including the interpretation. Furthermore, ECG machines are portable and are relatively inexpensive.

Need for new normative ECG standards

Many of those with LVH were only slightly above the Davignon norms.[19] If a more rigorous standard of 30 mm of R wave amplitude in RV_6 had been used, only 9 (2.3%) would have been considered to have LVH instead of 17 (4.3%). The Davignon criteria were developed from a white population, quite dissimilar to the current US population, using technology available >30 years ago. Although Rijnbeek norms for Dutch children are more current, they are not commonly used in this country and still lack generalizability to the more diverse US population. Lue's norms from 1,844 Taiwanese children show much lower amplitude measurements for LVH in that ethnic population,[20] further supporting the need for improved normative data by race, ethnicity, and gender in addition to age to decrease the overall false-positive rate and to provide higher specificity by relating to the population being evaluated.

We found that ECG diagnosis of LVH associated significantly with left ventricular mass on ECHO. It is important to note that left ventricular mass on ECHO correlates significantly with autopsy findings of LVH. Our study suggested that combinations of ECG measurements of LVH are more likely to identify LVH and increase ECG specificity than a single criteria alone. A larger population will be needed to confirm these findings.

Although we did not identify cases of HCM related to our small sample size and young age group, we hypothesize that ECG screening can be used to identify HCM in a larger age-appropriate young population >12 to 14 years. In addition, our study showed that z scores for echocardiographic measurements varied by race and gender, which has not been previously noted. This provides additional support that both echocardiographic and ECG normative values need to be standardized by race, ethnicity, and gender and not only by the currently used age standards.

Normal variants, false positives, and false negatives

Understanding the high prevalence of normal variants that we identified in Table III will decrease the use of additional and unnecessary testing. In addition, our study found an ECG false-positive rate of 7.8%, which was lower than other reports with rates as high as 16%.[17] Only 5.8% of these false positives would have generated echocardiographic testing because the others were related to electrical abnormalities. Our lower false-positive rate results from not counting benign variants and the fact that our young population was different from trained elite athletes. Most of our false positives came from miscategorizing LVH, indicating a need for clarity of ECG normative values for true-positive LVH. More specific normative standards should decrease false positives and the number of additional tests needed. Importantly, given the potential that a false negative can result in SCA, it is necessary to emphasize the value of using a screening test with the highest sensitivity possible in this population.

Long QT syndrome

It has been noted that not all with LQTS will have abnormal QTc intervals on ECG and that a small portion of the normal population will have QTc intervals $\geq$0.46 seconds.[21] Many young individuals with LQTS do not have or do not recognize their symptoms; family history is often not known. Thus, several at-risk individuals can be identified from the ECG, potentially avoiding SCA as a first symptom.[22,23]

Impact, screening concerns, and research implications

Assessment of feasibility should consider the potential impact of screening. Although the ECG and ECHO have little to no risk, concerns have been raised with regard to identifying asymptomatic individuals before clinical presentation. Knowledge gaps exist about the natural history of these individuals. However, the treatment modalities most commonly used for these conditions such as β-blocker medications are of low risk when contrasted with the potential catastrophic effects of an SCA. Additional studies are needed on treatment of asymptomatic youth identified with potentially serious conditions.

Another concern that has been raised regards the possibility of misclassifying children or of unnecessarily suspending athletic activity. In our study, most of those with false-positive findings returned to activity with a true-negative diagnosis within a few days or weeks. Although some parents and individuals may continue to worry about possible heart conditions and others may feel "cleared" for life, appropriate education of screening program participants and their families should minimize these potential misconceptions. More research is needed to determine the best ways to minimize these important largely psychosocial impacts. Our experience has been that these potential concerns have not restrained parents

and school-aged children from being willing to undergo screening tests, especially when most testing and results are available in a single setting. We did not find undue anxiety in any of the subjects in this study, even those identified with potential serious problems, but we did not perform formal testing. Such an evaluation should be undertaken in association with screening to better understand and minimize this potential, unintended, but negative aspect of screening.

The cost of screening to individuals and society has been raised as a potential negative impact of ECG screening. Although cost-effectiveness analysis was beyond the scope of this study, the ECG is a low-cost test, and our rate of additional testing was relatively low. Further cost-effectiveness studies will be needed to evaluate this concern.

Study limitations

This study had small numbers relative to the prevalence of the conditions associated with SCA. Although several abnormalities were identified, we recognize that our study population was not a representative sample of the population at risk for SCA. Patient or physician selection could have introduced bias, although we referred those who had specific concerns and were looking for a clinical cardiology consultation to our cardiology clinic. Our study, planned as a feasibility and methodology study, was not designed to be adequately powered to indicate the prevalence of conditions associated with SCA in children or to determine the overall prevalence of unidentified heart conditions in healthy children. Nevertheless, this study does show that the ECG can be helpful in identifying a variety of cardiac conditions that had not previously been noted by primary pediatricians and family physicians in apparently healthy children.

Summary and conclusions

Our pilot study demonstrates that it is feasible to screen children and adolescents with ECG in addition to history and physical examination. We have provided a methodology for this type of screening. We have shown that the ECG has the potential to identify serious cardiovascular abnormalities, many of which will not be recognized by history and physical examination in healthy school-aged children. Echocardiogram further improves the identification of abnormalities such as coronary artery anomalies or dilated aortic root. Once identified, there are very effective treatments for these conditions, although knowledge gaps do exist regarding the best application of these treatments. Our methodology could be used in a large multicenter national study to determine the validity of the ECG to identify the common conditions associated with SCA in the school-aged US population. Moreover, new normative values of ECG measurements using current technology in different ages, genders, races, and ethnic groups representative of the US population should be developed and are expected to improve sensitivity and specificity of the ECG. With a larger sample size, the best ages to screen children will be determined, and the best methodology to find specific conditions will be identified. Decisions to apply screening to youth in the United States should be derived from such a large-scale US research study of the application of ECG-based screening to a school-aged population.

Acknowledgements

We wish to thank the ECG technicians and the ECG administrative staff and echosonographers from the ECG and Echocardiographic Laboratories of The Children's Hospital of Philadelphia for their assistance in collecting ECG and echocardiographic data.

Disclosures

Funding sources: supported by the Chair's Initiative of the Department of Pediatrics of The Children's Hospital of Philadelphia and the Evelyn R. Tabas Chair in Pediatric Cardiology. No extramural funding was used to support this work.

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Appendix. Questionnaire

Participant/Parent Heart Health Questionnaire

_____

Date _____

Participant's Name _____
First Name Middle Name Last Name

Date of Birth _____ Age _____ Sex: _____ Grade _____

Race (Check one) _____ White
_____ Black or African-American
_____ Hawaiian or other Pacific Islander
_____ Asian
_____ American Indian/Alaskan Native
_____ More than one race
_____ Unknown

Ethnicity_____ Hispanic

Mother's Name _____
Father's Name _____
Home Address _____
_____
_____

Telephone Number (Home) _____
(Cell) _____
Primary Pediatrician's Name _____
Name of Pediatric Practice _____
Primary Pediatrician's Phone Number _____
Address of Pediatric Practice _____
_____

Participant Health Information

_____

Has the student ever had a problem with any of the following?
Please circle yes (Y) or no (N) for each question.

Y N Does your child have an allergy to adhesive tape?

Yes *No* *Explain*

Y N 1. Asthma? _____
Y N 2. Diabetes (high blood sugar)? _____
Y N 3. High blood pressure? _____
Y N 4. High cholesterol? _____
Y N 5. Seizures or convulsions? _____
Y N 6. Sickle cell anemia? _____
Y N 7. Hearing problems? _____
Y N 8. Anxiety or Depression? _____
Y N 9. Rheumatic fever? _____
Y N 10. Heart murmur? _____
Y N 11. Any other heart problems? _____
Y N 12. Chest pain with or after exercise? _____
Y N 13. Dizziness with or after exercise? _____
Y N 14. Shortness of breath with exercise? _____
Y N 15. Getting more tired than friends during exercise? _____
Y N 16. Fainting or passing out during exercise? _____
Y N 17. Fainting or passing out at any time? _____
Y N 18. Racing heart beat? _____

Y N 19. Extra heart beat? _____
Y N 20. Missed heart beat? _____
Y N 21. Has the student ever had any heart testing done, such as echocardiogram, stress test, tilt table, etc.?

Name of Tests:	Results:
_____	_____
_____	_____
_____	_____

Y N 22. Does the student have any other health problems?
_____
_____

Y N 23. Has the student ever been hospitalized?_____

When:	For what illness (s):
_____	_____
_____	_____
_____	_____

Y N 24. Does the student take any prescription or over the counter medication or any herbal or nutritional supplements?

Name of Medication (s):	Dose:
_____	_____
_____	_____
_____	_____

Y N 25. Has the student ever been restricted from playing sports, from gym class or other physical activities?
Reason: _____
_____

Y N 26. Does the student smoke cigarettes? _____

Nutrition and Exercise information

(Please answer the following questions about the student)

_____

What is your current weight? _____
Are you happy with your current weight? Yes No
If not, what is your desired weight? _____
How many meals do you eat each day? _____
How many times a day do you eat snacks? _____
How many cans of soda do you drink each day? _____
Have you ever tried to diet? Yes No Are you currently dieting? Yes No
Do you ever avoid certain types of food: Yes No
(please circle) carbohydrates, fats, meat, salt, _____
Have you ever had an eating disorder? Yes No

Does your child participate in any organized sports teams (club, school, other)? (For example: soccer, football, weight lifting, etc.) Yes No

Type of sport	Hours/Week	Time of Year	Comments
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Do you participate in any recreational or play activities (playground, club, school) that require physical effort? (For example: skiing, canoeing, cycling, dancing, swimming). Yes No

Type of sport	Hours/Week	Time of Year	Comments
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Do you exercise? (For example: recreational play, aerobics class) Yes No

Type of exercise:	Number of times per week:
_____	_____
_____	_____
_____	_____

Do you have gym class in school? Yes No

How many days each week?	For how long? (# of minutes)
_____	_____

Family Health History

Please answer the following questions regarding the participant's family history.
Please circle *Y*es or *N*o for each question and explain under which side of the family this occurred.

Has any member of the student's family had any of the following and indicate who, for example grandmother, aunt, uncle, etc?

			Mother's side of Family	**Father's side of family**
1. Died suddenly?	Y	N		
2. Died with no known reason?	Y	N		
3. Died of a heart problem before age 35?	Y	N		
4. Died of a heart problem before age 50?	Y	N		
5. Died while exercising?	Y	N		
6. Heart attack?	Y	N		
7. Heart failure?	Y	N		
8. Heart rhythm problem?	Y	N		
9. Fainting or passing out?	Y	N		
10. High blood pressure?	Y	N		
11. High cholesterol?	Y	N		
12. Diabetes?	Y	N		
13. Overweight/obesity?	Y	N		
14. Marfan Syndrome?	Y	N		
15. Hypertrophic cardiomyopathy	Y	N		
16. Long QT Syndrome	Y	N		
17. Wolff-ParkinsonWhite Syndrome	Y	N		

- Unable to get a family history from Participant due to _____
- Unable to get a family history from Mother's side of family due to _____
- Unable to get a family history from Father's side of family due to _____

Additional Comments: _____
_____
_____

_____ _____
Participant Signature Parent Signature