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The Influence of Body Mass Index on Long-Term Fitness From Physical Education in Adolescent Girls

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Abstract

BACKGROUND—Physical education (PE) can improve physical fitness; however, little research has evaluated PE's long-term influence. The purpose is to determine PE's longitudinal effects on fitness in a group of adolescent girls and to determine whether body mass index (BMI) status influenced any potential effects.

METHODS—Participants were enrolled in daily PE throughout their ninth grade. Data were collected at baseline and at the end of 9th, 10th, and 11th grades. BMI (kg/m²) was classified into Centers for Disease Control and Prevention percentiles. Fitness was estimated from a 3-stage step test (change in exercise heart rate (HR) indicated improved fitness) and analyzed using repeated measures general linear modeling with adjustments for baseline BMI, baseline age, ethnicity, intervention status, and moderate-to-vigorous physical activity outside PE.

RESULTS—Complete data were available for 131 girls (61% of sample) who were predominantly African American, 13.8 ± 0.4 years, mean BMI 24.7 ± 6.1 kg/m² at the ninth-grade baseline. Overall, stage 1 HR (bpm) decreased from baseline to 9th grade (−5.5 ± 1.3, *p* < 0.0001), baseline to 10th grade (−7.2 ± 1.4, *p* < 0.0001), and baseline to 11th grade (−7.0 ± 1.5, *p* < 0.0001). Change differed by BMI status; fitness improvement was significant for normal and overweight, but not obese girls. After 2 years, change in stage 1 HR (bpm) was significantly different between BMI categories: normal-weight girls versus obese girls (−10.0 ± 3.2, *p* = 0.002) and overweight girls versus obese girls (−9.3 ± 3.9, *p* = 0.02).

CONCLUSION—Fitness differences by BMI exist after a PE program in adolescent girls: fitness improved and was maintained in normal-weight and overweight girls, whereby obese girls had no improvement in fitness.

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Human Subjects Approval Statement

The protocol of the study was approved by the institutional review boards of Johns Hopkins University and the University of Maryland, College Park.

Keywords

longitudinal; African American; cardiorespiratory fitness; BMI; high school-based intervention; maintenance

Current physical activity recommendations encourage children and adolescents to accumulate at least 60 minutes per day of moderate-to-vigorous physical activity (MVPA).¹ However, only 35% of females aged 6–11 years are reaching these goals, and this drastically decreases to 3% in 12- to 15-year-olds.² This adolescent physical activity decline is especially apparent during high school years³ and in African American girls.^{4,5}

Adolescents with low levels of physical activity are also more likely to have lower fitness levels.⁶ In adolescents, an inverse relationship exists between age and fitness: as age increases, fitness levels decrease.⁶ Longitudinal studies show a decline in adolescent girls' fitness levels from 9th to 12th grade⁷ and also from adolescence into young adulthood.⁸ Decreased fitness levels during adolescence are also associated with increased prevalence of obesity⁶ and increased clustering of cardiovascular risk factors.⁹ Higher fitness levels are associated with more favorable cardiovascular disease risk factors;^{10,11} therefore, it is important to prevent the natural decline of adolescent fitness in order to improve or maintain their overall health through maturation into adulthood.

Recommendations from the Centers for Disease Control and Prevention (CDC)¹² and the American Heart Association¹³ state that schools and physical education (PE) programs play a central role in providing opportunities for children and adolescent physical activity. Comprehensive school-based PE interventions have successfully increased physical activity levels in high school adolescents.^{3,14–16} Furthermore, PE programs for adolescents have shown improvements in other health-related outcomes, such as body mass index (BMI), adiposity, and body composition.^{17,18} Increases in physical activity from PE have shown maintenance over time for both children and adolescents;^{19–21} however, little research has evaluated the longitudinal effects of PE specifically on adolescent fitness.²² Thus the purpose of this study was to determine the longitudinal effects of an 8-month PE class on fitness in a group of urban, mostly African-American, adolescent girls.

METHODS

This study analyzed data collected for Project Heart, a randomized controlled trial in a Baltimore City, Maryland high school.²³ The trial was designed to test the effects of a life skills-oriented physical activity intervention, conducted in PE class, on physical activity and cardiorespiratory fitness relative to the standard PE class in high school girls.

Subjects

Project Heart participants were recruited in fall 2000, 2001, and 2002 from ninth grade at an all-female public high school. Recruitment involved (1) student and parent presentations at summer freshman orientation classes, (2) letters sent from the principal to families along with brochures and study details and appropriate forms for participation, and (3) presentations made during PE class to all ninth-grade girls enrolled in eligible PE classes.

Eligibility inclusion criteria included willing and able to participate in all aspects of the intervention, enrolled in ninth grade at the high school, enrolled in 2 consecutive semesters of PE, and parental/guardian written informed consent. Exclusion criteria included having a medical condition that excused a student from meeting the Maryland State PE requirements, pregnant or breast-feeding at baseline, planning to leave the area prior to follow-up period, current participation in another clinical trial that conflicted with Project Heart, or household member involved in any aspect of Project Heart. Parental consent was obtained and baseline testing occurred within the first 4 weeks of the fall semester and prior to randomization. Follow-up data occurred after 8 months of the PE intervention, and then at the end of each academic year for an additional 2 years of follow-up. All data were collected before school, after school, during PE class period, and during lunch. Figure 1 displays the Project Heart study design, measurement, and recruitment.

Instruments and Procedures

Trained technicians collected all measurements. Participants were asked to remove their shoes and wear light clothing prior to obtaining measures of weight and height. Weight was determined using a calibrated physician scale and rounded to the nearest 0.1 kg. Height was assessed using a standard wall stadiometer and estimated to the nearest 0.1 cm. Body mass index was calculated from the equation of weight (kg) divided by the squared height (m²). Body mass index status was determined by the CDC growth charts: <85th percentile = normal weight, 85th to 95th percentile = overweight and >95th percentile = obese.²⁴ The CDC growth charts used are specific to both age and gender; thus, BMI categories were determined at each time point because of the increase in age over time (baseline, 9th grade, 10th grade, and 11th grade).

Physical Fitness Measure—Cardiorespiratory fitness was estimated with a submaximal step test. The protocol included 3 stages of 3-minute exercise and was designed to estimate fitness from heart rate (HR) response to stepping up and down on 3 steps (stage 1: 1.75 in.; stage 2: 3.5 in.; stage 3: 5.25 in.) where height was calculated to meet the required energy expenditure of progressive stages corresponding to 50%, 60%, and 70% of HR reserve.²⁵ Target HR (THR) was determined by 70% HR reserve using the Karvonen formula: $(220 - \text{age}) = \text{estimated maximal HR}$; $\text{THR} = [\text{estimated maximal HR} - \text{resting HR} \times .70] + \text{resting HR}$.²⁶ Resting HR was estimated from an average of 3 measures after 10 minutes of seated rest, with at least 1 minute between subsequent measures. Stepping was performed at 30 steps/minute cadence determined by a metronome. Exercise HR was monitored with a Polar Heart Rate monitor (Polar Electric Inc., Lake Success, NY), recorded, and averaged from 3 measurements during the final minute of each of the 3-minute stages (2:30, 2:45, and 3:00 minutes). If the THR was reached or exceeded, the fitness step test was terminated at the end of the stage. This submaximal fitness field test was created specifically for 14-year-old overweight adolescent girls with low fitness and elevated cardiovascular risk in order to detect small changes in fitness.²⁵

Physical Activity Measure—The 7-day physical activity recall instrument (7DPAR) was utilized to assess the current physical activity.^{23,27} This instrument was interviewer administered in which each participant was asked to recall her sleep and physical activity for

the previous 7 days. The questionnaire is divided into 3 periods of the day: morning, afternoon, and evening. Morning is the time period between breakfast and lunch, afternoon is the time period between lunch and dinner, and evening is the time after dinner. Specific questions were added for activity in specific periods of the school day: before school, during school but not in PE class, during school in PE class, after school (afternoon), and after school (evening). Participants are asked to categorize their activities into moderate (4 METS), hard (6 METS), or very hard (10+ METS). Moderate activity is considered walking briskly, very hard is a running pace, and hard is the intensity between moderate and very hard. Light activity (1.5 METS) is any activity not considered to be sleep or any of the aforementioned intensities. Data collected from this questionnaire were used to quantify and estimate intensity, type, and frequency of physical activity for both weekend and weekday times. Previous research has shown that 7DPAR is reliable and valid against an HR monitor and a pedometer in a group of adolescents.²⁷ The 7DPAR has also been shown to be valid and reliable in a multiethnic sample including Caucasian, African Americans, Latinos, and Asians.²⁷

For the purposes of this study, an estimate of the time spent in average daily MVPA outside PE class was calculated as the sum of time, in hours, spent in moderate, hard, and very hard activities (4+ METS), which did not include PE. This measure was used to capture the physical activity habits of the participants outside PE in order to account for any other physical activity that may have occurred throughout the day. Moderate-to-vigorous physical activity in 10th and 11th grade PE was also calculated as the sum of minutes in moderate, hard, and very hard activities recorded only during PE class. This measure was used to capture any physical activity during PE class which occurred within 10th and/or 11th grades.

PE: Intervention and Control Curriculum—All study participants were enrolled in a full academic year (9 months, 2 semesters) of PE, with the fall semester consisting of individual sports and activities and the spring semester focusing on team sports. These 2 semesters fulfilled the Maryland high school graduation requirements. Classes were scheduled 5 days per week for 47 minutes. Girls were given approximately 12 minutes to change their clothes, resulting in 35 minutes of structured class time. During baseline testing, all classes participated in a tennis unit. Following measurement, girls were randomly assigned to the 8-month life skills-oriented PE class (intervention) or the 8-month standard PE class (control).

All students were required to change into PE uniforms daily, and “sitting out” was strongly discouraged by all instructors of both the intervention and control groups. The intervention group was taught and delivered by an instructor hired by the project to carry out the initiatives of the intervention. Units and lesson plans were chosen within the curriculum requirements (team sports, individual sports) to increase physical activity in class and promote out-of-class physical activity through behavioral skills training.²³ Instructional units and daily class activities were designed to appeal to adolescent girls and maximize active time in each class. For example, a unit of aerobic dance was added to the fall semester, and softball was excluded in favor of soccer in the spring. Small groups and station work were strategies frequently used to increase class activity. Other activity units were walking/

jogging, fitness (resistance training, circuit training), and swimming in the fall, and basketball, volleyball, and recreational games in the spring.

The standard PE curriculum (control) was taught by certified PE teachers employed by the school. Units that were included in the standard PE curriculum (control), but not the intervention, included badminton, softball, and lacrosse. Students were encouraged to master sports skills and spent time in drills and skill practice. In sport units, the standard condition employed full game play more than the intervention.

Data Analysis

All statistical analyses were performed using SAS software version 9.1 (SAS Institute, Cary, NC), and significance level was defined as $p < 0.05$. Mean HR at the end of stage 1 (stage 1 HR) was analyzed at baseline and follow-up for comparison between girls. An improvement in fitness was determined by a decrease in stage HR.

Fitness Over Time Within BMI Categories—Repeated measures general linear modeling was used to compare the baseline and 3 follow-up HR measures. Measurement averaged 9 months between baseline and the first follow-up (9th grade) and 12 months for each follow-up thereafter (10th, 11th grade). Because age influences both BMI and fitness, a spatial power covariance structure was utilized to account for the variable time of data collection (Model 1). To control for fitness changes that may have resulted from physical activity occurring outside PE class or during PE in 10th or 11th grade, we also ran an additional model that controlled for any MVPA accumulated throughout the day (before, during, or after school) (eg, after-school programs, band practice, sports teams, etc) and PE MVPA minutes in 10th and 11th grade PE (Model 2). Including these variables as covariates in the model allows us to attribute any fitness changes to the ninth-grade PE program rather than other physical activity opportunities. Differences between the control and intervention groups regarding some of the baseline characteristics and physical activity measures have been previously published.²³ The current analysis ($n = 131$) did not show differences between the control and intervention PE groups for baseline BMI ($p = 0.83$) and stage 1 HR at follow-up 1 in 9th grade ($p = 0.28$), follow-up 2 in 10th grade ($p = 0.68$), or follow-up 3 in 11th grade ($p = 0.42$). However, the intervention group had a higher baseline stage 1 HR (150.4 ± 16.3 vs 143.7 ± 14.3 , $p = 0.01$) and younger age compared to the control group (13.7 ± 0.05 vs 13.9 ± 0.04 , $p = 0.04$). Thus, to control for any differences between the intervention and control groups, an intervention term was added as an additional covariate to the analysis. Importantly, the intervention term was not significant in any of the analyses for longitudinal stage 1 HR. Furthermore, as a result of no differences between standard (control) and intervention PE curriculum for our main outcome measure (stage 1 HR), girls were combined into one group for the analyses. In addition to adjusting for baseline age, baseline BMI, intervention status, MVPA outside PE (Model 2 only), models also adjusted for ethnicity to control for any differences in fitness response related to these variables. Finally, these analyses were also stratified by baseline BMI category to examine stage 1 HR within BMI category including all covariates.

Differences Between BMI Categories for Fitness—Fitness improvements, change in stage 1 HR, (stage 1 HR) at any time point were calculated as the number of beats (bpm) different from stage 1 HR baseline. Each participant's baseline stage 1 HR was subtracted from the subsequent follow-up (9th, 10th, and 11th grades). General linear modeling was used to compare stage 1 HR (bpm) among normal-weight, overweight, and obese girls at each time point with adjustments for baseline stage 1 HR, baseline BMI category, baseline age, ethnicity, intervention status, and MVPA outside PE at the specific time point (9th, 10th, or 11th grade).

RESULTS

Two hundred and twenty-two girls were recruited into the Project Heart Study. Two hundred and fifteen girls were randomized into standard (control) or intervention PE. For this analysis, sample size was reduced due to missing data for baseline age and BMI ($n = 4$), ethnicity ($n = 2$), and baseline stage 1 HR ($n = 1$). Furthermore, due to the statistical procedures for the longitudinal analysis, data points for each follow-up time period were required; thus, approximately 61% ($n = 131$) of the original randomized sample had complete fitness data from baseline, 9th grade, 10th grade, and 11th grade (Figure 1). Most of the loss to follow-up was from students who left the school and it was not feasible to collect their fitness data. Despite the loss to follow-up through 11th grade, there were no significant differences for baseline BMI, baseline age, or baseline mean HR between the total sample and the subsample of girls with complete fitness data (Table 1).

As previously mentioned, intervention and control groups were combined into one group due to no differences in fitness at follow-up for stage 1 HR at any time point. Mean age at baseline was 13.8 ± 0.4 years, with 77% 14 years of age. Approximately 87% were African American. BMI (mean $\pm$ SD) was 24.7 ± 6.1 kg/m², which corresponded to the 90th percentile for age and gender according to CDC growth charts.²⁴ Approximately 53% of the girls were classified as normal weight, 23% overweight, and 24% obese (Table 1). There were 14% and 21% of girls enrolled in 10th and 11th grade PE, respectively.

Fitness Over Time Within BMI Categories

Figure 2 presents stage 1 HR at baseline, 9th grade, 10th grade, and 11th grade. Overall, stage 1 HR significantly decreased between baseline and 9th grade (difference between 9th grade and baseline [mean $\pm$ SE]: -4.4 ± 1.3 bpm, $p = 0.0006$), baseline and 10th grade (-6.4 ± 1.4 bpm, $p < 0.0001$), and baseline and 11th grade (-5.1 ± 1.5 bpm, $p = 0.0005$) (Model 1). No changes in significance were noted when adding the covariates, which accounted for physical activity occurring throughout the day (excluding PE) and physical activity during PE in 10th and 11th grades (Model 2: difference between 9th grade and baseline [mean $\pm$ SE]: -5.5 ± 1.3 bpm, $p < 0.0001$; baseline and 10th grade -7.2 ± 1.4 bpm, $p < 0.0001$; baseline and 11th grade -7.0 ± 1.5 bpm, $p < 0.0001$) (Figure 2).

As noted above, there were no differences in results when adding the covariate for physical activity levels outside PE. However, to account for any residual confounding of physical activity outside PE, we present the remaining results with MVPA outside PE included as a covariate. When the girls were stratified by baseline BMI categories, fitness increased only

for the normal-weight and overweight girls. Stage 1 HR improved from baseline at 9th grade (normal weight: -5.6 ± 1.7 bpm, $p = 0.001$; overweight: -7.7 ± 2.1 bpm, $p = 0.008$), from baseline to 10th grade (normal weight: -7.1 ± 2.1 bpm, $p = 0.001$; overweight: -10.0 ± 2.7 bpm, $p = 0.0004$), and from baseline to 11th grade (normal weight: -8.1 ± 2.3 bpm, $p = 0.0006$; overweight: -10.0 ± 2.6 bpm, $p = 0.0003$) (Figure 3). Decreases in stage 1 HR were not significant in obese girls from baseline to 9th grade, 10th grade, or 11th grade (Figure 3).

Differences Between BMI Categories for Fitness

One-, two- and three-year changes in fitness (stage 1 HR) between baseline BMI groups are displayed in Figure 4. In general, the normal-weight and overweight girls maintained their fitness improvements over time. In contrast, obese girls had no improvements in fitness, with a general trend toward a decrease in fitness over time, though this was not significant. Differences between BMI groups were not significant from baseline to 9th grade (overall p -value for differences between BMI groups: $p = 0.24$) or from baseline to 10th grade ($p = 0.11$). However, stage 1 HR was significantly different between BMI groups from baseline to 11th grade ($p = 0.008$): stage 1 HR was greater among normal-weight girls compared to obese girls (difference between stage 1 HR: -10.0 ± 3.2 bpm, $p = 0.002$) and greater in overweight girls compared to obese girls (-9.3 ± 3.9 bpm, $p = 0.02$).

DISCUSSION

Normal-weight and overweight girls who participated in an 8-month PE program showed significant decreases in stage 1 HR, indicating an improvement in fitness, as well as maintenance of these effects over the 2 subsequent years. In contrast, obese girls showed no fitness improvements in response to the same PE program. After 2 years of follow-up, differences for stage 1 HR became significant between BMI groups: both normal-weight and overweight girls had significant greater improvements in fitness compared to obese girls.

Fitness has not been typically measured in other high school-based PE interventions. Many long-term studies for school-based PE interventions have examined maintenance of physical activity levels over time,^{19–21} though only one was identified for high school students,¹⁹ and none examine physical fitness. Fitness has been shown to be a more stable measure than physical activity from youth to adulthood in females²⁸ and highly related to cardiometabolic clustering and risk,¹⁰ making it an important measure to monitor over time. Some, but not all, PE interventions for children and young adolescents show improvements in aerobic fitness measures.^{22,29} Some adolescent PE interventions have utilized surrogate measures for fitness, such as resting HR¹⁷ or recovery HR,³⁰ which also show inconsistent improvements for fitness.^{1,24}

Few studies have examined fitness changes across adolescent BMI groups. Hannon found that there were no differences in the accumulation of physical activity between overweight versus non-overweight high school students during PE.³¹ However, when normal-weight and overweight/obese adolescents were enrolled in the same PE program, only higher fitness levels were observed in the normal-weight adolescents,³² which suggests that BMI status may differentially influence the effects of PE interventions. One PE intervention exclusively in obese adolescents did show improvements in fitness from a specialized school-based PE

program.³³ However, the study only included obese individuals, so comparisons with overweight and normal-weight responses could not be performed. Furthermore, this intervention involved smaller group size, which may have influenced the changes in fitness. Our results did not show improvements for fitness in obese girls; however, it is important to note that the obese girls did not have a significant decline in fitness over time. Thus, despite no significant improvements for fitness, the PE program may be preventing the natural decline over time.

Strengths and Limitations

There are several strengths and limitations to this study. The ability to study a school-based PE intervention and its long-term effect is a unique opportunity. However, there was no true control group for comparison, thus results should be interpreted accordingly. If we did have a control group who was not enrolled in PE, we would expect declines in both physical activity levels^{4,5,34} and fitness⁷ over time. In addition, our 3-year longitudinal analyses had natural attrition due to school transfers ($n = 46$). However, no differences in the subsample were found in comparison with the entire group at baseline, thus the subsample is representative of the total sample. All girls are from a single urban magnet high school, thus these results may not be generalizable. Our measure for fitness was a submaximal field test. Due to the nature of a school-based PE intervention, a more valid measure of fitness was not available. However, these methods have been validated to measure fitness previously in a similar group of adolescent girls.²⁵ Although HR is highly variable among adolescents of differing BMI status and also changes with age, we were able to statistically control for baseline BMI and age in order to account for these differences. We also were able to attribute the fitness improvements entirely to the ninth-grade PE program by controlling for any physical activity occurring outside the PE program at any time point. Finally, our group was primarily African American girls, and the analysis is not adequately powered to examine ethnic differences due to the small sample of Caucasians. Despite these limitations, this research describes some of the first evidence to suggest a long-term effect of a PE program on adolescent girls. However, future studies are needed to replicate and confirm these findings which include a control group for comparison and more sophisticated measures of fitness and physical activity.

Conclusion

In summary, our results found that an 8-month PE program was associated with a reverse in the natural decline in fitness over time in normal-weight and overweight adolescent girls, and actually maintained these improvements over 2 subsequent years. Fitness improvements and maintenance were not found in obese girls; however, neither was a significant decline among these girls. These findings have important implications for the inclusion of PE programs for adolescent girls to prevent the decline in fitness over time. Future studies are needed to address specialized PE programs for obese girls in order to improve fitness.

IMPLICATIONS FOR SCHOOL HEALTH

Healthy People 2010 has 3 objectives related to PE: (1) increase the proportion of the nation's public and private schools that require daily PE for all students, (2) increase the

proportion of adolescents who participate in daily school PE, and (3) increase the proportion of adolescents who spend at least 50% of school PE class time being physically active.³⁵ In 2007, according to the National Youth Risk Behavior Survey, 46% of high school students did not attend PE classes at all and 70% did not attend daily PE classes.³⁶ PE requirements and participation rates decrease in American schools between 8th and 12th grade and participation rates are lowest in African Americans and low socioeconomic status individuals.³⁷ Given the results of our study, school districts should reconsider current policies of minimal requirements of PE in secondary education and support daily PE in at least the ninth grade to improve and maintain fitness over time.

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Figure 1. Project Heart study Design, Measurement, Randomization, and 3-Year Follow-Up
Frequencies represent percentage of total girls who were randomized to intervention and control groups (n = 215).

*Significant difference in stage 1 heart rate from baseline ($p < 0.05$).

Figure 2. Longitudinal Fitness Through 3 Years Following an 8-Month Physical Education Program in Adolescent Girls (n = 131)

Adjusted stage 1 heart rate (HR) at baseline, 9th grade, 10th grade, and 11th grade. Repeated measures general linear models were used to test differences in stage 1 HR between baseline and subsequent time points. Stage 1 HR in total number of girls had a fitness test at all 4 time points. Model 1 adjusted for baseline age, baseline body mass index, ethnicity, and intervention status. Model 2 adjusted for these covariates plus moderate to vigorous physical activity occurring outside physical education (PE) and 10th and 11th grade moderate-to-vigorous physical activity within PE. Significant decreases in stage 1 HR occurred from baseline to 9th grade, baseline to 10th grade, and baseline to 11th grade in both Model 1 and Model 2.

*Significant difference in stage 1 heart rate from baseline ($p < 0.05$).

Figure 3. Longitudinal Fitness Through 3 Years Following an 8-Month Physical Education Program in Adolescent Girls Within Baseline Body Mass Index (BMI) Category

Normal-weight and overweight girls had significant decreases in stage 1 heart rate (HR) from baseline to ninth grade adjusted for baseline age, baseline BMI, ethnicity, intervention status, and moderate-to-vigorous physical activity outside physical education. No significant differences were found in stage 1 HR in obese girls between baseline and any succeeding time point.

* Significant Δ stage 1 heart rate between normal weight and obese ($p < 0.05$).

§ Significant Δ stage 1 heart rate between overweight and obese ($p < 0.05$).

Figure 4. One-, Two-, and Three-Year Fitness Changes Among Normal-Weight, Overweight, and Obese Adolescent Girls Following an 8-Month Physical Education Program

General linear models tested significant differences in the change in stage 1 heart rate (HR) between baseline body mass index (BMI) categories. Models adjusted for the baseline stage 1 HR, baseline BMI category, baseline age, ethnicity, intervention status, and moderate-to-vigorous physical activity outside physical education. Significantly higher change in stage 1 HR was found between normal-weight versus obese girls and between overweight versus obese girls at 11th grade.

Table 1

Baseline Demographics and Characteristics of Project Heart Participants^{*}

	Total Sample	Subsample of Girls With Complete Fitness Data		Normal Weight	Overweight	Obese
N	215	131		70	30	31
Age (years) (mean ± SD)	13.8 ± 0.4	13.8 ± 0.4		13.8 ± 0.5	13.6 ± 0.5	14.0 ± 0.2
13 n (%)	49 (23)	28 (21)		16 (23)	12 (40)	0 (0)
14 n (%)	163 (76)	101 (77)		53 (76)	18 (60)	30 (97)
15 n (%)	3 (1)	2 (2)		1 (1)	0 (0)	15 (3)
African American n (%)	178 (83)	114 (87)		60 (86)	27 (90)	27 (87)
BMI (kg/m ²) [‡] (mean ± SD)	25.1 ± 6.8	24.7 ± 6.1		20.2 ± 1.8	26.6 ± 4.0	33.0 ± 0.4
Normal weight n (%)	110 (51)	70 (53)		70 (100)	—	—
Overweight n (%)	55 (26)	30 (23)		—	30 (100)	—
Obese n (%)	50 (23)	31 (24)		—	—	31 (100)
Stage 1 heart rate (bpm) (mean ± SD)	145.3 ± 17.9	147.3 ± 15.7		143.7 ± 15.3	151.1 ± 16.1	151.8 ± 14.6

^{*} No significant differences occurred among mean age, baseline body mass index, or stage 1 heart rate between the total sample and the subsample of girls with complete fitness data.

[‡] CDC percentiles: normal weight <85th percentile; overweight 85th and <95th percentile; obese 95th percentile (20).