

FITNESSGRAM® Friday: A Middle School Physical Activity and Fitness Intervention

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ABSTRACT

Int J Exerc Sci 5(1) : 4-15, 2012. Texas Senate Bill 530 (2007) mandated fitness assessment as part of the annual K-8 Physical Education (PE) curricula, yet no studies have reported interventions designed to improve and quantify individual student passing rates or individual school performance. Students (Total 2008-2010 N=1484; 729 females, 755 males; mean age = 11.85 y; mean BMI = 22.69 or > 90%-tile, overweight) were evaluated on individual FITNESSGRAM® performances in a cross-sectional analysis of 6th graders comparing baseline scores (year 1) with outcomes of a physical activity intervention in years 2 and 3. Students participated in regular PE classes (including campus wellness center activities) with a once a week focus (FITNESSGRAM® Friday) on improving mile run scores and other assessment scores. Students significantly improved FITNESSGRAM® scores following the PE intervention to levels similar to state reported averages. On average, boys improved their pushups by 32.7%, trunk lift by 17.4% and mile run times by 29.5%. Averages for girls improved by 15.4% for pushups, 6.7% for truck lift, and by 38.6% for the mile run. The percentage of boys in our study achieving all six FITNESSGRAM® tests in the HFZ was 3% at baseline and 22% following intervention. The percentage of girls meeting the criteria for the HFZ on all six FITNESSGRAM® tests was 4.5% at baseline and 20% following intervention. This study provides a potential model for fitness success in other middle school PE interventions, in Texas and the nation.

KEY WORDS: Adolescents, physical education, fitness testing, public health policy

INTRODUCTION

The prevalence of childhood and adolescent overweight and obesity has increased dramatically in the last 40 years (20, 32). It has been estimated that the prevalence of overweight (> 85% percentile) for children

and adolescents will almost double by the year 2030 to about 30% overall, and by 2070, over half of U.S. children and adolescents will become overweight (32). Sub-groups of youth, like Black girls and Mexican American boys will reach this level by 2050. In Texas, the 2007 National

Survey of Children's Health found that 20.4 % of children ages 10-17 were obese as compared to 16.4% nationally (11). If these trends do not change, the prevalence of overweight and obesity in youth at the national and state levels pose serious future adult public health challenges like increased chronic disease risks and prevalence (cardiovascular disease, Type-2 diabetes, metabolic syndrome, etc.), and increased future health-care costs (11, 32).

In Texas, recent legislation like Senate Bill 530 (2007) sponsored by Senator Jane Nelson and State Representative Rob Eissler provided an unfunded mandate that required yearly health-related fitness (HRF) assessment for public school students in grades 3-12, and also required daily "moderate or vigorous" physical activity (MVPA) for grades K-5, with 4 semesters required in grades 6-8 (4). Other Texas legislation, since the 1970's, historically has targeted skill-related fitness and HRF testing as ways to combat youth overweight/obesity problems and low fitness levels (18). It has been argued by many, that all fitness testing should be abandoned in schools, while others have suggested that we should test students on HRF items as part of new models (e.g. the integration of physical activity behaviors, fitness levels, motor skills, and cognition) that promote long term physical activity and health (2, 3, 6, 8, 12, 13, 17, 23, 24).

The enactment of SB 530 (2008) resulted in the adoption of the FITNESSGRAM® as the statewide testing assessment, which was developed originally in 1982 by the Cooper Institute for Aerobic Fitness in Dallas, TX, and is now financially supported via Texas Fitness Now Grants (18, 21, 26). The

FITNESSGRAM® includes six types of assessment measuring five HRF areas: body composition, aerobic capacity, muscular strength, muscular endurance and flexibility. These assessments determine if students are in a "healthy fitness zone" (HFZ) for their age and gender.

The Texas Youth Fitness Study (TYFS, 2008-2010) included significant correlations between HRF levels (passing 6 tests in the HFZ) and various indicators of academic achievement (26). The relationships included: higher levels of fitness (particularly cardiovascular fitness) were associated with better academic performance; higher levels of fitness were associated with better school attendance; higher levels of fitness at a school were also associated with fewer disciplinary incidents; and, counties with high levels of cardiovascular fitness tended to have high passing rates on the Texas Assessment of Knowledge and Skills (TAKS™). California has previously found similar FITNESSGRAM® and academic relationships for 5th, 7th, and 9th graders with regards to state standards for reading and mathematics (1).

The actual FITNESSGRAM® scores (N > 2.5 million students tested yearly) collected from the TYFS study are difficult to interpret, because only aggregate scores were reported by schools and individual student data could not be evaluated (33). A more recent report, conducted by the Texas Education Agency (TEA) evaluating participating Texas Fitness Now grantee schools (2007-08 to 2009-10), found similar relationships for FITNESSGRAM® and TAKS™ scores, and reported that there were significant increases on several HRF

assessments (average 2 to 5 %), based on aggregate data and the use of paired t-test comparisons (26).

A search of the literature revealed no studies that have evaluated individual student performance, or school performance over time, using complete FITNESSGRAM® scores as performance study outcomes. The purpose of this study was to evaluate the FITNESSGRAM® scores of a cross-sectional sample of 6th grade students in one Texas school at baseline (year 1), and following a physical activity intervention designed to improve and quantify scores in years 2 and 3. We hypothesized that the intervention groups would have better on all FITNESSGRAM® assessments compared to the baseline control group.

METHODS

Participants

A total of 1484 (N = 729 girls, 755 boys; mean age; 11.85 ± 0.6 y; height: $1.54 \pm .08$ m; body mass: 54.72 ± 16.73 kg; Body Mass Index - BMI: 22.69 ± 5.72 kg/m²) students (approximately N = 500 per year) in 6th grade physical education (PE) classes (2008-2010) from one middle school in the Seguin Independent School District (ISD), Seguin, TX were included in the study. The demographics of the student population were representative and stable of that found in the Seguin ISD with 66.13% considered economically disadvantaged (or low social economic status, SES), and 61.3% classified as Hispanic, 30.8% White, and 7.1% African-American. Data for the study were analyzed retrospectively, and IRB approval from Texas State University (#EXP2011I2187) was granted.

Setting and General Procedures

Beginning in the spring of 2008 (year 1), FITNESSGRAM® baseline data, collected according to standard guidelines, were obtained on students participating in PE classes as part of the requirements of Texas SB 530 and reported to the TEA (16). Specific yearly FITNESSGRAM® data (years 1-3) collected at the middle school included age, gender, height, weight, BMI, push ups, curl ups, trunk lift, back-saver (BS) sit and reach, and mile time.

In the spring semester of 2009, students began participating in their normal PE classes (including campus wellness center activities), with the exception of a new curricular emphasis on a once a week intervention, "FITNESSGRAM® Friday." Students attended PE classes for 55 minutes, every other day and engaged in MVPA for approximately 50% of each class period, which meant that students participated in an average of 137.5 minutes of MVPA in PE every two weeks (or 16.3% of the daily recommended amount of 60 minutes for youth) (10, 25). The intervention, designed by the school's certified PE teachers, focused on helping students improve baseline mile run scores (which were very low at baseline, see Table 2) and other FITNESSGRAM® assessment scores. Students practiced at least one component of the FITNESSGRAM® each week, which has been a similar strategy used by teachers of core academic subjects (English, math, and science) in Texas, with regards to preparing for yearly mandated TAKS™ testing. Along with the PE curricular intervention, students were provided random drawing incentives for MP3 players based upon their regular participation on Fridays, and the school

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staff, and local university students (Texas Lutheran University - TLU) often served as mentors for students, as well as running partners. Students practiced and learned individual pacing techniques for the mile with their instructors on a school trail developed by the Sequin ISD to promote increased school and community levels of physical activity.

Study Design and Statistical Analysis

A cross sectional study design using a three-stage approach for data analyses was used to determine differences in fitness values. The first stage of the analyses compared the two intervention years to assure that no significant differences were apparent for the intervention groups. Stage two of the analyses compared the intervention groups to the baseline control sample to determine what differences existed among FITNESSGRAM® outcomes.

The final analyses stage included the development of a regression equation to show which factors in the FITNESSGRAM® outcome measures significantly predicted group involvement (intervention/baseline). Descriptive statistics, Chi Square values for change, and multivariate analyses were calculated and performed using SPSS, version 15 statistical package software on the available FITNESSGRAM® data for 1484 students during years 2008 - 2010. A significance level of $p < 0.05$ was used to determine significance.

RESULTS

Intervention Equivalence

A multivariate analysis of variance was used to determine if the data for the two intervention years could be combined for later comparison of the intervention to the control amongst the FITNESSGRAM®

Table 1. Comparison of intervention group data.

Variable	Female				Male			
	2009		2010		2009		2010	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (years)	11.80	0.58	11.78	0.62	11.99	0.64	11.88	0.60
Height (m) ‡	1.53	0.06	1.54	0.07	60.91	3.55	61.09	3.23
Weight (kg)	55.51	16.47	54.62	15.90	55.26	16.72	55.84	18.02
BMI (kg/m ²)	23.12	5.58	22.83	5.89	22.74	5.44	22.84	5.88
Push Ups ‡	10.18	8.12	8.80	5.97	14.35	10.77	14.72	8.90
BS Left ‡	10.60	1.78	9.94	1.79	9.29	1.99	8.92	1.91
BS Right ‡	10.57	1.71	10.05	1.71	9.49	1.96	8.89	1.94
Curl Up ‡	40.36	22.88	31.13	19.10	46.71	22.92	44.58	22.97
Trunk Lift	11.47	0.94	11.44	1.12	11.40	1.08	11.32	1.24
Mile Time (min) ‡	11.98	2.20	12.98	2.49	11.14	2.77	11.78	2.83

‡ Significant differences at $p < 0.05$

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Table 2. Comparison of Intervention to Baseline Data

<u>Variable</u>	<u>Female</u>				<u>Male</u>			
	<u>Baseline (N=246)</u>		<u>Intervention (N=483)</u>		<u>Baseline (N=270)</u>		<u>Intervention (N=485)</u>	
	<u>4.5%</u>		<u>20%</u>		<u>3%</u>		<u>22%</u>	
<u>Passed All 6 tests</u>								
<u>Mean</u>	<u>Mean</u>	<u>SD</u>	<u>Mean</u>	<u>SD</u>	<u>Mean</u>	<u>SD</u>	<u>Mean</u>	<u>SD</u>
Age (years)	11.75	0.70	11.79	0.60	11.89	0.70	11.93	0.62
Height (m)	1.53	0.08	1.54	0.07	1.55	0.09	1.55	0.09
Weight (kg)	52.69	16.43	54.21	16.26	54.66	17.13	55.22	17.15
BMI (units)	22.23	5.65	22.96	5.74	22.48	5.84	22.80	5.69
Push Ups ‡	7.28	5.74	9.44	7.07	9.05	7.03	14.55	9.77
BS Left	11.07	1.55	10.24	1.82	9.51	2.31	9.08	1.95
BS Right	11.10	1.57	10.29	1.73	9.57	2.24	9.08	1.95
Curl Up	33.30	20.77	35.37	21.40	39.84	22.54	45.53‡	22.95
Trunk Lift ‡	10.89	1.48	11.45	1.04	10.30	2.00	11.35	1.17
Mile Time (min) ‡	17.66	3.86	12.52	2.41	15.50	4.23	11.50	2.82

‡ Significant differences at $p < 0.05$

outcome measures. Dependent variables for the analyses were year of intervention and gender while the independent variables consisted of the scores for the six tests measured by the FITNESSGRAM®. Table 1 contains the descriptive results between the intervention groups.

The results of the multivariate analyses showed significant differences between gender for height ($F=3.99; p < 0.05$), pushups ($F=83.90; p < 0.05$), BS left ($F=93.11; p < 0.05$), BS right ($F=89.76; p < 0.05$), curl up ($F=48.77; p < 0.05$), and mile time ($F=37.20; p < 0.05$). When controlling for the differences associated with gender, there were no significant differences between the trials except for curl up data ($F=6.28, p < 0.05$). A post hoc analysis of the frequencies of those that passed the curl up

tests found that there was no significant difference between females that passed the curl up test in 2009 (91.4%) compared to 2010 (90.8%; $\chi^2 = 0.060$). There was, however, a significant difference in the percentage of subjects that passed the curl up results for the males in 2010 (98.5%) when compared to 2009 (92.8%; $\chi^2 = 10.49$). When comparing the curl up results for males in all three years, the baseline year was found to be significantly different from the two intervention years ($F=5.92, p < 0.05$), but scores for all years exceeded the healthy zone scores for the FITNESSGRAM®. Since the curl up results were the only results that were significantly different among the two intervention years, and subsequent analyses of the curl up data found that the baseline year was significantly different from the two intervention years, the

intervention years were combined for analyses purposes.

Intervention Comparison to Baseline

A multivariate analysis of variance was used to determine if the data for the FITNESSGRAM® outcome measures were significantly different between groups (baseline/intervention) and sex. The descriptive means for these analyses are presented in table 2.

The analysis revealed significant differences between intervention and baseline data when controlled for by gender for pushups (F=15.18, p<0.05), (trunk lift (F=11.02, p<0.05), and mile run times (F=106.40, p<0.05). Chi square analyses were used to determine the impact of the intervention on increasing the number individuals who met the minimal HFZ standards. The graphical representations of the chi square analyses are presented in figure 1.

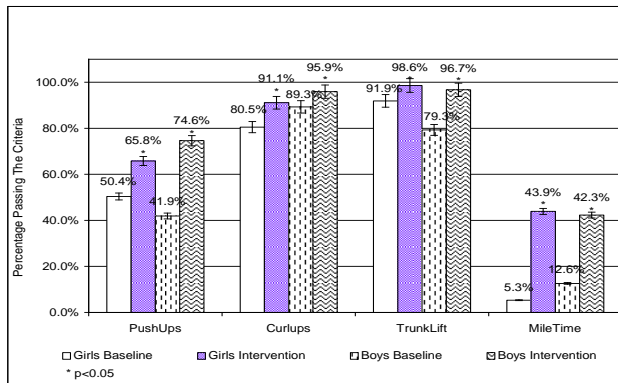


Figure 1. Passing rates of baseline and intervention.

Both boys and girls improved in pushups (boys $\chi^2= 79.91$, p<0.05; girls $\chi^2= 16.26$, p<0.05), curl ups (boys $\chi^2= 12.51$, p<0.05; girls $\chi^2= 16.93$, p<0.05), trunk lift (boys $\chi^2= 61.16$, p<0.05; girls $\chi^2= 21.40$, p<0.05), and mile time (boys $\chi^2= 70.60$, p<0.05; girls $\chi^2=$

113.85, p<0.05). The previous data compared groups based upon meeting the minimal HFZ requirements as suggested by Cooper’s Clinic. When comparing the baseline to intervention group data for the percentage of boys and girls that exceeded the HFZ scores, both boys and girls in the intervention group had significant increases in the percentage of students exceeding the HFZ scores for pushups (boys $\chi^2= 85.64$, p<0.05; girls $\chi^2= 18.54$, p<0.05), curl ups (boys $\chi^2= 13.34$, p<0.05; girls $\chi^2= 17.39$, p<0.05), and mile time (boys $\chi^2= 72.6$, p<0.05; girls $\chi^2= 113.9$, p<0.05). A graphical representation of those individuals exceeding the HFZ target scores is presented in figure 2.

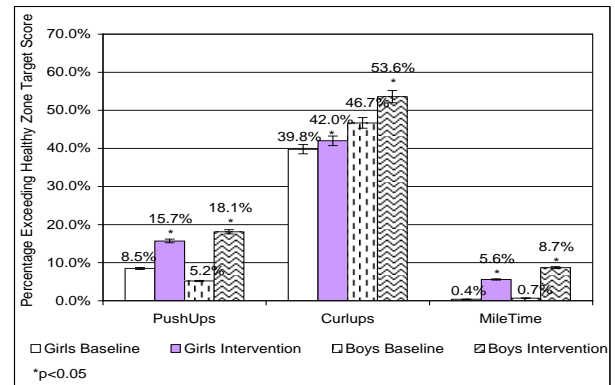


Figure 2. Comparison of baseline and intervention percentages for exceeding the upper limit of the healthy zone target scores. (Improvement of the mastery of the FITNESSGRAM® components).

The final analyses conducted for the data included a stepwise multiple logistic regression analyses to determine the impact of the FITNESSGRAM® variables within group involvement. The analyses showed that the variables of BMI, mile time, pushup, trunk lift, and curl up significantly predicted group involvement ($\chi^2= 678.23$, p<0.05) and that these variables accounted for 37% of the variance associated with the

model ($r^2=0.367$, $p<0.05$). Table 3 represents the logistic regression analyses.

Table 3: Logistic regression analyses.

Variable	Beta	Standard Error	χ^2	Sig.
Mile Time	-0.482	0.029	276.94	0.000
Trunk Lift	0.344	0.050	47.04	0.000
BMI	0.124	0.015	70.31	0.000
Pushup	0.046	0.012	13.85	0.000
Curlup	-0.018	0.004	25.71	0.000
Constant	0.977	0.710	1.92	0.163

DISCUSSION

The present study, to our knowledge, represents the only study that has analyzed individual, cross-sectional student performance in one school over time (baseline compared to intervention), using complete FITNESSGRAM® scores as performance study outcomes. An important finding of the study was that compared to baseline, a simple intervention (teaching to, and practicing the FITNESSGRAM® tests) helped improve student performance significantly on pushups, trunk lift scores, and mile run times (see figure 1). On average, boys improved their pushups by 32.7%, truck lift by 17.4% and mile run times by 29.5%. Averages for girls improved by 15.4% for pushups, 6.7% for truck lift, and by 38.6% for the mile run. The mean student scores following intervention were similar for pushups and slightly higher (~10%) for the trunk lift based on gender compared to all Texas middle school results reported (34). The intervention mean mile run times were

similar for those reported for other Texas middle school boys and girls for cardiovascular health combined for gender by ethnicity and socioeconomic status (SES) (34). The mean intervention values for boys and girls for the BS sit and reach, and curl ups were above the minimum health fitness zones.

These findings are even more relevant since students like those in our study population tend to have lower FITNESSGRAM® performances than those in schools categorized as having low diversity, and high SES (34). The study population also had mean BMI's for girls and boys (~22.8) that were $\geq 90^{th}$ percentile, and would categorized them as being overweight (20,32). The percentage of boys in our study achieving all six FITNESSGRAM® tests in the HFZ was 3% at baseline and 22% following intervention (see table 2), which was above the state average of 21.7 % reported in 2010 (5). The percentage of girls meeting the criteria for the HFZ on all six FITNESSGRAM® tests was 4.5% at baseline and 20% following intervention (see table 2), which was remained below the state average of 30.2% reported in 2010 (5). Following intervention over 50% of boys and girls in our sample passed at least 5 of the FITNESSGRAM® tests, which speaks positively for the general success of "FITNESSGRAM® Friday."

In one previous study, Weiller and colleagues in 1994 (33) reported that Hispanic middle school students (from a school district with 20.67% Hispanics) of the same age as our study population had mean BMI's of 20.32 for boys; 19.91 for girls, and FITNESSGRAM® mean mile runs times of 9.17 minutes (mins.) for boys; 9.89

mins. for girls. It is noteworthy that the students in the Weiller et al. study had significantly lower mean BMI's and faster mile times than our study population. Interestingly, the differences in these variables, between study populations most likely reflects the changes in the rates of youth overweight and obesity that have occurred in the past 15-20 years (20, 32).

Our results also indicate that the "FITNESSGRAM® Friday" intervention significantly increased the percentage of boys and girls that not only met HFZ standards, but exceeded them for pushups, curl ups, and the mile run. Figure 2 shows that on average 12.9%, 6.9%, and 8% of the study population of boys improved their scores above the FITNESSGRAM® healthy zone standards respectively for standards on pushups, curl ups, and the mile run. On average 7.2%, 2.2%, and 5.2% of the study population of girls improved their scores above the FITNESSGRAM® HFZ standards respectively for standards on pushups, curl ups, and the mile run. Our study results with regards to percentage improvements in student FITNESSGRAM® scores for meeting, or exceeding the recommended health fitness zones were both as high, and most higher than those reported in the Texas Fitness Now results (26). Based upon aggregate data for all Texas students increases in FITNESSGRAM® performance for all assessments averaged only between 2% and 5 % in 2010 (26). Furthermore, our results suggest that training students in physical activities such as the mile run, including pacing and running style, may translate to improved spontaneous physical activity levels.

Prediction of group association (baseline or intervention) in our study population was significantly influenced by student performance on the mile run, trunk lift, BMI, pushups, and curl ups. These variables accounted for 37% of the variance for predicting whether a student was associated with the baseline or intervention group. Furthermore, the variables associated with predicting group association suggest that practitioners should focus on cardiovascular fitness (mile run) and strength/flexibility (trunk lift, pushup, and curl ups) versus body composition for initial success. Post hoc analyses found that 3% of the baseline group compared to 29% of the intervention group who did not meet the minimal standards for BMI successfully met the standards for the mile run time. These results suggest that intervention among cardiovascular fitness variables was more efficient (greater rate of improvement) than intervention among body composition variables. Our results also support the findings of others who have reported that school PE interventions that used BMI as an outcome marker of change had low success rates for improvements, and BMI was resistant, or slow to change (15, 25, 27, 31).

The improvement and prediction of FITNESSGRAM® performance may have important additional value besides fitness level evaluation for student populations like ours, with regards to academic success. Van Dusen and colleagues (30) have recently reported a significant dose-response relationship between all FITNESSGRAM® scores and TAKS™ scores in a large sample (>300,000) of Texas students for all FITNESSGRAM® variables. They found that cardiovascular fitness

(mile run or Pacer test) provided the largest inter-quintile differences in TAKS™ scores of 32 to 75 points. They also encouraged PE practitioners to emphasize cardiovascular fitness and strength over body composition to support potential academic achievements. While we did not collect TAKS™ data on our study population, it would be interesting to do so in future studies, and to evaluate whether FITNESSGRAM® and academic success are just related or causal in nature.

The positive results of our study intervention are due at least in part to the interest and cooperation of the Seguin ISD. In addition, the leadership of the teachers in the school studied helped to minimize typical barriers encountered in data collection in school settings that can be challenging for inexperienced investigators, or those unfamiliar with school policies. Numerous researchers have reported the various challenges to implementing and assessing programs like the FITNESSGRAM® in schools (6, 14, 19, 35). For example, in Texas it has been found that while the majority of PE teachers support SB 530, and adhere to standardized testing protocols, they had numerous problems with testing experiences and opportunities to prepare students adequately to take the test, as well as, providing them opportunities to be physically active enough to increase fitness levels (35). Other factors like large PE class sizes, a lack of certified PE teachers, lack of student knowledge and motivation, and inappropriate test participant clothing can also make it challenging to not only adequately assess student fitness levels, but to design and implement programs to

improve physical activity and fitness levels (6).

At the present there are numerous national and state policymakers that have focused on school PE as important area for intervention to increase physical activity and physical fitness to combat issues like the obesity crisis (2, 7, 9, 11, 22, 28, 29, 31). States like California and Texas have implemented mandatory fitness testing of public school students as part of their efforts to promote health and fitness for youth (1, 4). Based upon the cross-sectional, individual data in this study an intervention like FITNESSGRAM® Friday can have a significant effect on fitness performance in students who represent a study population that typically performs poorly on such evaluations. These results have implications for policymakers, school administrators, and practitioners. While the authors do not specifically endorse one physical activity or fitness program intervention versus another, we do feel that it is important for researchers to study the impact of SB 530 and FITNESSGRAM® interventions in order to translate meaningful results to legislators and policymakers. For education and health policymakers, if fitness testing is mandatory or made mandatory, then appropriate resources should be made available to obtain and report individual student data for surveillance and longitudinal follow-up.

In addition, school administrators should be encouraged to consider providing PE teachers the resources and time necessary to implement effective physical activity and fitness programs to successfully prepare and pass evaluations like the

FITNESSGRAM®. Practitioners should consider basic interventions like described in this study, whereas, students became familiar with the fitness test, practiced the test, conditioned themselves in PE classes via physical activity participation, and are provided incentives to do their best on the test.

A primary strength of this study is the large sample size based on individual data, in a school with stable student demographics over three years, versus aggregate data that has been used and reported in previous FITNESSGRAM® performance research reports. We found that a simple intervention could not only improve FITNESSGRAM® scores in a challenging population of middle school students based on demographics, but significant improvements were made for some students who actually exceeded the upper levels of the healthy fitness zones for pushups, curl ups, and the mile run. We accounted for confounding factors like gender by using multistage, multivariate data analyses. Finally, we reported individual performance variables from FITNESSGRAM® testing that were significantly predictors of group performance (baseline versus intervention), and showed that the most important predictor variable is mile run performance followed by trunk lift, BMI, pushups, and curl ups. Body composition as represented by BMI in our study was a significant predictor of baseline to intervention performance; however cardiovascular fitness as measured by the mile run time performance of the student was much more influential.

The main limitations of this study are its cross-sectional design and lack of controls that does not allow for comparison between individuals over time, or the determination of causation factors that may be related to FITNESSGRAM® performance. The intervention effects in terms of specific dosage were not collected, or evaluated. However, the PE teachers were experienced, and both certified with master's degrees. Our results were based upon 2010 FITNESSGRAM® HFZ standards, which were changed recently for aerobic capacity and body composition by the Cooper Institute based on National Health and Nutrition Examination Survey results (16, 22, 26). Finally, the study was based on a large convenient sample, and this may limit the generalizability of the study to other populations.

The results of study support the fact that FITNESSGRAM® performance can be improved in a large population of middle school PE students representing a large percentage of minorities, that have low SES via a simple intervention that can be sustained over time. Future studies are needed that include larger randomized samples with individual, longitudinal data to verify our results. However, this study does reinforce that student FITNESSGRAM® success can be achieved by increasing student familiarity, practice, and preparation for testing, while providing incentives for participation and performance.

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author ES is employed elsewhere promoting youth outdoor recreation experiences. We would like to thank administrators of the Seguin ISD for their support of this study.

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