International Journal of Physical Education, Sports and Health 2017; 4(6): 146-150

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2017; 4(6): 146-150

www.kheljournal.com
Received: 24-09-2017
Accepted: 26-10-2017

Larry Proctor
Ph.D, Department of Kinesiology, Sport and Leisure Studies Grambling State University Grambling, LA, USA

L Jerome Brandon
Ph.D., FACSM, Department of Kinesiology and Health Georgia State University Atlanta, GA, USA

Correspondence
L Jerome Brandon
Ph.D., FACSM, Department of Kinesiology and Health Georgia State University Atlanta, GA, USA

Obesity, fitness and academic outcomes of minority children in the Louisiana delta

Larry Proctor and L Jerome Brandon

Abstract
The impact of fitness, and overweight on the cognitive development of children and adolescents is not clear and this is especially true for low income minority children. Therefore, this study was designed to assess associations of body mass index and fitness with academic outcomes in African American children living in the Louisiana Delta. From 256 children contacted, 104 (58 males and 46 females) with an average age of 9.1 ± 1.5 years participated in this study. Results indicate that overweight and poor cardiorespiratory fitness, in otherwise fit children, were consistent predictors of reading and math scores for these children. Although further study is needed, these findings suggests overweight and to a lesser extent, cardiorespiratory fitness are more associated with academic outcomes in African American children than other measures of fitness and that overweight is more associated with academic outcomes in low income African American female than African American male children.

Keywords: overweight; African American children; academic outcomes; fitness

1. Introduction
The obesogenic culture has resulted in a drastic decrease in physical fitness and an exponential increase in childhood overweight in the United States during recent decades. [1, 2, 3]
This finding is especially true for African American children (AAC). Considerable attention had been given to wellness and public health implications of these changes, but less attention has been provided to the possible impact overweight and poor fitness has on academic outcomes. Further, if overweight and poor fitness independently or accumulatively impacts European American (EAC), Hispanic American (HAC) and African American children in a similar manner is unclear [2, 4, 5]. The literature is mixed as to the influence of physical fitness on academic outcomes; some report a positive relationship [6, 7, 8, 9], whereas other studies have observed small [10, 11] or negative relationships [2]. Most of the participants in these studies were EAC.
Overweight has increased and fitness has decreased since the 1990s while reading and math scores are generally slightly higher today than they were in 1990 for math among fourth grade students. However, math scores have not increased since 2007 for these children. The increases observer for math scores may be related to improvements in technology that enables children to focus more on math and math related skills. Reading scores have been relative flat since the 1990s among children [2, 12].
The literature indicate that a negative relationship exist between overweight and academic outcomes, but the reported manner in which overweight impacts academic outcomes in these studies is not consistent. One study reported that teacher's perception of overweight children results in the child receiving lower grades [13], while another study suggested the child's self-concept results in the child having lower expectations of themselves, thus earning lower grades [14, 15]. In a dissertation study in our lab, Andrews [16] observed that overweight also impact standard test scores in a manner similar to its impact on grades in low income urban minority children.
Most of the findings reported in the literature have been with EAC and may or may not have similar effects on children from other population groups. The prevalence of overweight is highest among African American female children. Physical activity is unacceptably low for outcomes [3, 11].

Therefore, the purpose of this study was to determine the associations of overweight, fitness and academic outcomes in low income African American children in the Louisiana Delta.

2. Materials and Methods

A descriptive research design was employed in this investigation as 256 students were contacted and 104 children (58 males and 46 females) from the Louisiana Delta, a low socioeconomic area, volunteered to participate in this study. Based on body mass index (BMI) assessments data from our lab, 40 participants per cell provides a power greater than 0.80. The participants were from low income families as eighty-five percent of the children received free or reduced-price school lunch. They had not participated in a structured physical fitness program in the previous six months, were not on special diets and were not taking cardiorespiratory or weight management medication. Parents signed an institutional approved informed consent form and accent from the child was obtained before the child was allowed to participate in this study.

2.1 Assessments

The same investigators complete the fitness and body composition assessments and the assessments were made at school and at a local Boys and Girls club. The participants were measured for field based fitness variables and protected math and reading scores were obtained from schools by the investigators. The research design required that participants be measured for fitness near the end of the school year and math and reading scores were final grades for the school year. The fitness variables measured were curl-ups for muscular endurance, push-ups for muscle strength, sit and reach for flexibility, pacer test for cardiorespiratory fitness and BMI for overweight assessments. Each participant was measured for all variables.

Height was measured using a stadiometer and body weight was assessed using a calibrated electronic beam scale with a digital readout to the nearest 0.1 kilogram (kg). Weight expressed in kgs was divided by height in meters squared to calculate BMI. Sit and reach was measured using the procedure from Fitnessgram where the participant kept one leg extended and in contact with the sit and reach box. The other leg was flexed and the sole of the foot was flat on the floor. The hands were placed one on top of the other and extended as far forward as possible over the measuring scale. The value was recorded to the nearest half-inch.

Strength was estimated using pushups as the participant assumed a position with the hands wider than the shoulders, toes curled under and the back and legs straight. The body was lower until the arms were at 90% angle. The arms were then extended to go back to the starting position. Correct form was important and the activity was stopped when the second form correction was necessary. Form corrections included 1) not achieving a 90% angle with the elbows, 2) stopping to rest while performing the next exercise, 3) not maintaining correct body position with a straight back and 4) not extending arms fully.

Fitnessgram curl up test was completed as the student begins by lying on their back, knees bent at approximately 140 degrees, feet flat on the floor, legs slightly apart, and arms straight and parallel to the trunk with palms of hands resting on the mat. The fingers were stretched out and the head was in contact with the mat. A 3.0 inch measuring strip was placed on the mat under the students legs so that their fingertips were just resting on the nearest edge of the measuring strip. The feet could not be held or rest against an object. Keeping heels in contact with the mat, the student curled up slowly, sliding their fingers across the measuring strip until the fingertips reach the other side, then curled back down until their head touches the mat. Movement was smooth and at the cadence of 20 curl-ups per minute (1 curl-up every 3 seconds).

Maximum cardiorespiratory endurance was estimated from the Fitnessgram Progressive Aerobic Cardiovascular Endurance Run (PACER) test. The test was performed on a flat non-slip surface as marking cones were placed 20 meters apart. A PACER test disc and CD player were used to provide the PACER test timing for the assessment. The test involved continuous running between the two lines on which the cones were placed within the time frame of the recorded beeps. The time between recorded beeps decrease each minute requiring an increase in run pace. The subjects continued until they were unable to keep pace with the beeps for two consecutive runs between the cones. The test includes 21 levels which require approximately 21 minutes to complete. The score was the number of minutes (levels) completed before the child was unable to keep up with the recording for two consecutive trips. Pacer trips were converted into VO_{2max} values following the procedures presented by Burns *et al*. [17].

2.2 Data Analysis

The data were analyzed for each gender using descriptive statistics as means and standard deviations were calculated for all participants. Data were evaluated for differences with independent t-tests. Relationships were determined by Pearson correlation coefficients and for predictive value with linear stepwise regressions.

3. Results and Discussion

The children were 9.1 years of age and differed only for weight when evaluated on differences for personal characteristics and academic scores (Table 1). The reading and math scores of the males and females were not different ($p > 0.05$), but the females tended to have higher scores. Based on the grading scales of the school, the average grade of the students was "B-".

Males had less flexibility, lower BMI and weight, but greater strength. Male BMI values of 19.4 kg/m^2 and cardiorespiratory fitness (CRF) values of 32.2 $ml \cdot kg^{-1} \cdot min^{-1}$ placed them in the need improvement zone of the 2015-2016 Fitness gram test.[18] Males were within the acceptable fitness zone (see Table 2) for muscle endurance, strength and flexibility. Female BMI values of 22.1 kg/m^2 and CRF values of 28.0 $ml \cdot kg^{-1} \cdot min^{-1}$ placed them in the need improvement zone. Females met or exceeded the Healthy Fit zone standards for the other fitness assessments evaluated in this study.[18] While Fitness gram does not provide CRF norms for nine-year old children, the value for 10-year-old children was 37.3 $ml \cdot kg^{-1} \cdot min^{-1}$ and the values decreased with increasing age above 10 for the next few years. Thus, we classified the children in this study as not meeting the CRF standards. [18]

When the fitness and academic data were evaluated for relationships, BMI and CRF were related to math (r= -.36 & .53, respectively) and BMI was related to reading (-.50) in the males. There were no relationships between any of the other fitness variables and academic outcomes for the male children (Table 3).

Math and reading shared relationships with BMI and CRF (r = -.60 & .58, respectively for math and -.63 and .61, respectively for reading) in the females. This suggest that as

BMI decreases and as CRF increases reading and math scores of the children increased and the strength of the relationships suggests that BMI or overweight and CRF has a more profound effect on AAC female academic outcomes in the Delta than males.

To further assess the association between academic scores and fitness, reading and math were entered in separate stepwise regression analyses by gender to determine the predictive efficiency of academic scores from BMI and other fitness variables. BMI was the only predictor in the math equation as it accounted for 36% of the variance with a standard error of estimate (SEE) of 5.8% for the females (Table 4). Strength, BMI and flexibility were significant predictors of reading skills for the females as the equation accounted for 64% (SEE = 5.9%) of reading variability. BMI also was a significant predictor of reading scores in the males as it explained 25% of the variance with a SEE of 5.9%. CRF was a predictor of math scores for males as it accounted for 28% of the variance.

3.1 Discussion of Findings

The purpose of this study was to determine the association of overweight and fitness with academic outcomes in low income AAC in the Louisiana Delta. These data indicate that overweight (measured by BMI) and CRF (estimated by a PACER test) values outside the healthy fit zone in children otherwise within the healthy fit zones are consistent predictors of reading and math scores in low socioeconomic status (SES) AAC. [18] Overweight was found to be more associated with academic outcomes in low income AAC than the other fitness variables, including CRF.

The no child left behind act placed a high-priority on academic outcomes, often at the expense of physical education, physical activity and healthy weight management in schools. [2] Evidence suggests that public schools, educators and administrators need to recognize the importance of active lifestyles and body weight management on student health and academic success. There in a need for a movement toward a holistic child approach to properly develop all aspects of children; emotional, social, physical and mental or academic outcomes and this is especially true for low SES AAC [2, 8, 12, 19].

Males BMI values of 19.4 kg/m^2 and females BMI values of 22.1 kg/m^2 and the CRF values or 32.2 ml·kg^{-1}·min^{-1} for males and 28.0 ml·kg^{-1}·min^{-1} for females placed both in the need improvement fitness zone of Fitnessgram. [17] The participants were within the healthy fitness zone for the other measured fitness variables. BMI was inversely related to reading and math in both males and females. This finding is consistent with other research in the literature. Lu *et al.* [19] report that male students tend to produce poorer academic outcomes when they are either underweight or overweight, but the adverse effect are larger for underweight boys than for overweight boys. By contrast, the academic outcomes of female students are adversely affected only if they are overweight. [20]

Kim *et al.* [21] found that overweight males (compared with healthy weight males) had odd ratios of 1.182 (1.048-1.332, p=0.01), 1.461 (1.294-1.648, p<0.00), and 1.443 (1.256-1.657, p<0.00) of having average, poor, and very poor academic outcomes, respectively. Overweight females had 1.374 (1.098-1.718, p=0.005), 1.672 (1.339-2.089, p<0.001), and 1.887 (1.478-2.409, p<0.001) greater odds of having average, poor, or very poor academic outcomes, respectively. Thus, consistent with findings in the present study, overweight was negatively associated with academic outcomes in both males and females. Results from the current and referenced studies indicate that children and adolescents would benefit from weight management skills and healthy lifestyle choices to prevent overweight and, possibly, improve academic performance. [21]

In the present study, children were in the healthy fitness zone for strength, endurance and flexibility and other than BMI, only CRF as estimated by VO_{2max} calculated from the PACER test was related to math and reading scores for the females and with math scores in males. The literature appears to be mixed regarding this finding as some studies indicate that fitness enhances academic outcomes while other studies indicate that fitness has little or no relationship with academic outcomes. The literature is not clear as to one gender being more impacted than the other. [2, 6, 8, 9, 10]

Regular physical activity is reported in some studies to be associated with improved academic outcomes in school-age youth. This contention is supported by multiple studies which indicate that students who perform more hours of physical activity and/or more intense physical activity have better academic outcomes than those who are less physically active. [2, 9, 21, 22, 23] The VO_{2max} test results in the present study indicate that the children were relative inactive as their values were outside the Fitnessgram healthy fit zone for 10-year old children. On the other hand, Chen and colleagues [24] assessed cardiovascular fitness, sit-and-reach flexibility and bent-leg curl-ups along with reading and math scores at the beginning and conclusion of the school year. Their findings showed that improvement in cardiovascular fitness, but not muscular endurance or flexibility was significantly related to greater academic outcomes [24]. However, most of the participants in their study were EAC. The same pattern was observed in the present study as CRF was related to math and reading in the AAC, but the other fitness variables, excluding BMI, were not related to either of the academic variables.

Limitations of this pilot study is the sample is relative small and provide more of a trend rather than a validated outcome. Further, the findings from this study applies to AAC form low SES communities as only AAC were participants. Field based assessments, which are not as accurate as lab based assessments, were the data collected and used for fitness in this study. The CRF results were calculated form PACER trips and computational errors may have resulted. No healthy fit zone scores are provided for nine year old children in the Fitnessgram chart. Therefore, the comparison in this study are with 10-year old children. As the children became older their CRF Fitnessgram values decreased, so the authors are comfortable with concluding that the children in this study fell outside the healthy fit zone for CRF.

There are racial overweight disparities in children as AAC tend to have a greater prevalence than EAC. Reported associations in the literature relative to the impact of obesity on academic performance has been mostly reported for EAC and the associations may be different in AAC, especially low SES AAC [18]. In the current study the AAC were in the healthy fit zone for all variables except overweight and CRF and overweight and CRF were the only variables related to academic outcomes. There were stronger associations for the females than for the males. These findings are consistent with results of previous studies that AAC, especially females, who were in the healthy fitness zone performed significantly better ($P < 0.05$) in math and reading compared to those who are overweight. [25, 26] The children were from low SES backgrounds which may have contributed to the associations observed in this study. Although these findings need further validations, they have policy implications that schools and

communities should consider ethnic, cultural and racial issues that provide their students with the best opportunity for optimal weight management and CRF for academic success. [20, 23]

3.2 Tables

Table 1: The Personal Characteristics of the African American Participants

Variable	Males N = 58 X ± Sd	Females N = 46 X ± Sd	All Participants N =104 X ± Sd
Age (yrs.)	8.9 ± 1.4	9.3 ± 1.6	9.1 ± 1.5
Height (cm)	132.6 ± 11.4	132.1 ± 10.9	132.3 ± 11.1
Weight (kg)	35.2 ± 14.2	41.9* ± 18.3	38.2 ± 16.4
Math Scores (%)	86.6 ± 6.3	88.7 ± 8.8	87.6 ± 6.6
Reading Scores (%)	85.5 ± 6.5	87.0 ± 8.8	86.3 ± 7.7

*Means different based on sex at $p < 0.05$

Table 2: Comparison of physical fitness assessments in male and female African American Children

Variables	Males N = 58	Male Healthy Fit Zone Ranges	Females N = 46	Female Healthy Fit Zone Ranges
Body Mass Index (kg/Ht-m^2	19.4 ± 5.1*	14.2 – 18.9	22.1 ± 6.1	14.0 - 19.4
Push-ups (#)	9.8 ± 8.1*	≥ 6	6.3 ± 5.6	≥ 6
Curl Ups (#)	22.4± 18.7	≥ 9	20.2 ± 15.8	≥ 9
Flexibility (inch)	8.8 ± 2.4	≥ 8	9.7 ± 2.5	≥ 9
Cardiorespiratory (VO_{2max})(ml·kg^{-1}·min^{-1})	32.2 ± 3.0*	≤37.3#	28.0 ± 3.5	≤37.3#

*Means different based on sex at $p < 0.05$; Age specific norms from Fitnessgram[16]

#This value was for 10-year-old as Fitnessgram provides no need improvement zone value for nine-year-old children.

Table 3: Relationship between Fitness Assessments, Reading and Math skills in Male and Female African American Children

	Males N = 58		Females N = 46	
Variables	**Math**	**Reading**	**Math**	**Reading**
Muscle Strength (#)	.15	.06	-.03	-.09
Muscle Endurance(#)	.08	-.12	-.30	-.31
BMI (kg/m^2)	.36*	-.50*	-.60**	-.63**
Cardiorespiratory VO_{2max} ml·kg^{-1}·min^{-1}	.53*	-.32	.59**	.61**
Flexibility (cm)	-.17	-.10	.10	.14

*Relationship significant at $p < 0.05$; **Relationship significant at 0.01; BMI body mass index; VO_2 = volume of Oxygen uptake

Table 4: Reading and math scores predicted from fitness variables in African American Children

Variables	Male N = 58 R, R^2, SEE		Female N = 48 R, R^2, SEE	
	Reading	Math	Reading	Math
Body Composition				.60 36% 5.8%
Body Composition, Strength, Flexibility			.80 64% 5.9%	
Body Composition	.50 .25% 5.9%			
CRF (VO_{2max})		.53 28% 5.6		

Included variables are significant predictors of academic outcomes at $p < 0.05$; CRF ccardiorespiratory fitness; VO_2 = volume of oxygen uptake

Conclusions

Results from this study indicate that childhood overweight and poor CRF fitness not only causes health related complications, but also are associated with poorer academic outcomes in low SES minority children. The issue is more pronounced in females who have a higher prevalence of overweight than males. Interventions that focus on healthy weight management and more cardiovascular physical activity in children could have long term positive effects on the lives of these children. Thus, greater emphasis on weight management and exercise in young children should be included in schools health curriculum.

Reference

1. Boddy LM, Hacked AF, Stratton G. Changes in fitness, body mass index and obesity in 9-10 year olds. J Hum Nutr Diet. 2010; 23(3):254-259.
2. Castelli DM, Hillman CH, Buck SM, Erwin HE. Physical fitness and academic achievement in third- and fifth-grade students. J Sport Exer Psy. 2007; 29:239-252.
3. Ortega FB, Ruiz JR, Castillo MJ, Sjostrom M. Physical fitness in childhood and adolescence: a powerful marker of health, hit. J Obes. 2008; 32(1):1-11.
4. Efrat M. The Relationship between Low-Income and Minority Children's Physical Activity and Academic-Related Outcomes: A Review of the Literature. Health

Educ Behav. 2011; 38:441-451.
5. Taras H, Potts-Datema W. Obesity and student performance at school. J Sch Health. 2005; 75(8):291-295.
6. Fong D. California Department of Education. Health, Nutrition, and Physical Fitness, 2011. dfong@CDE.ca.gov
7. Taras H. Physical Activity and Student Performance at School. J Sch Health. 2005; 75(6):214-218.
8. Tremblay MS, Inman JW, Williams JD. The Relationship Between Physical Activity, Self-Esteem, and Academic Achievement in 12Year-Old Children. Ped Exer Sci. 2000;12:312-324.
9. Shephard RJ. Habitual physical activity and academic performance. Nutr Rev. 1996; 54:S32-S36.
10. Daley AJ, Ryan J. Academic performance and participation in physical activity by secondary school adolescents. Percept Mot Skills. 2000; 91:531-534.
11. Dwyer T, Sallis JF, Blizzard L, Lazarus R, Dean K. Relation of Academic Performance to Physical Activity and Fitness in Children, Ped Exer Sci. 2001; 13:225-238.
12. Desilver D. U.S. students improving – slowly – in math and science, but still lagging internationally, Pew Research Center, 2015; http://pewrsr.ch/1Cpiejw
13. Zavodny M. Does Weight Affect Children's Test Scores and Teacher Assessments Differently? Econ Educ Rev. 2013; 34:135-145.
14. Hunt JB. Obesity and Academic Outcomes, James B. Hunt, Jr. Institute for Educational Leadership and Policy. Web site: http://hunt-institute.org, 2009.
15. Bisset S, Fournier M, Pagani L, Janosz M. Predicting academic and cognitive outcomes from weight status trajectories during childhood. Int J Obes. 2013; 37:154-159.
16. Andrews EB. The relationship between body mass index, perceived weight, and academic performance in minority middle school students, Georgia State University dissertation, 2014.
17. Burns RC, Hannon JC, Allen BM, Brusseau TA. Convergent validity of the one-mile run and PACER VO2max Prediction models in middle school students. SAGE Open J, 2014, 1-8.
18. The Fitnessgram and Healthy Fitness Zones (HFZ). The Cooper Institute, Reference Guide on the California Physical Fitness Test (PFT). Resources Wed Pate at hhp: www.pftdata.org/resources.aspx, 2016.
19. Daniels DY. Examining attendance, academic performance, and behavior in obese adolescents. J Sch Nurs. 2008; 24(6):379-387.
20. Lu, Yu-Lung, Chou, Stephen Jui-Hsien, Lin, Eric S. Gender differences in the impact of weight status on academic performance: Evidence from adolescents in Taiwan. Children & Youth Services Rev. 2014; 46:300-314.
21. Kim J-H, Wi-Y. Association between Overweight/Obesity and Academic Performance in South Korean Adolescents. Central Euro J Pub Health. 2013; 21:179-183.
22. Fox CK, Barr-Anderson D, Neumark-Sztainer D, Wall M. Physical activity and sports team participation: associations with academic outcomes in middle school and high school students. J Sch Health. 2010; 80:31-37.
23. Esmaeilzadeh S, Kalantari H-A. Physical fitness, physical activity, sedentary behavior and academic performance among adolescent boys in different weight statuses. Meditern J Nutr Metab. 2013; 6(3):207-216.
24. Chen LJ, Fox, KR, Ku, PW, Taun CY. Fitness change and subsequent academic performance in adolescents. J Sch Health. 2013; 83:631-638.
25. Joshi P, Howat H, Bryan C. Relationship between Fitness Levels and Academic Performance. J Phys Ed Sport. 2011; 11:376- 382.
26. Harrington SA, Relationships of objectively measured physical activity and sleep with BMI and academic outcomes in 8-year-old children. Appl Nurs Res. 2013, 63-70.