

PHYSICAL ACTIVITY

Effect of Body Composition, Physical Activity, and Aerobic Fitness on the Physical Activity and Fitness Knowledge of At-Risk Inner-City Children

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Abstract

SHAPE America has highlighted the importance of developing physically literate children as part of quality physical education programming. Unfortunately, most children know little about physical activity and health-related fitness. The purpose of this study was to examine the physical activity and fitness content knowledge of at-risk inner-city children and determine if students who accumulate more physical activity, do more PACER laps, and/or have a lower BMI have higher levels of knowledge. Participants included 569 inner-city children (300 girls, 269 boys) from the Southwest USA who completed the PE Metrics knowledge test, wore a pedometer for 1 school week, completed the PACER test, and had their height and weight measured. Two-way and three-way factorial ANOVA tests were used to examine potential differences between genders, between grades, and among tertiles of physical activity and health-related fitness performance on the PE Metrics knowledge test. On average, students scored 38% on the PE Metrics knowledge test. Boys and girls scored similarly, sixth

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graders scored lower than fourth and fifth graders, and children who were in the low and high BMI tertiles scored higher than children in the medium tertile ($p < 0.05$). As school day step counts and PACER laps increased, knowledge scores trended higher. At-risk youth need additional opportunities to learn content knowledge related to physical activity and fitness. Increased physical activity and aerobic fitness were related to small increases in knowledge scores. Future interventions should focus on child behavior and knowledge.

One of the objectives of physical education programs is to develop physically literate children who possess the knowledge and skills to participate in activity for a lifetime (Society of Health and Physical Educators, 2013). Knowledge about physical activity (PA) and physical fitness has been highlighted as important for individuals to be active for a lifetime (Zhu, Safarit, & Cohen, 1999). Studies have suggested that children do not have the requisite knowledge needed to adopt healthy behaviors (Desmond, Price, Smith, Smith, & Stewart, 1990; Hopple & Graham, 1995; Keating, Chen, Guan, Harrison, & Dauenhauer, 2009; Liang et al., 1993; Prewitt et al., 2015). More specifically, Kulinna (2004) examined this in an elementary school with the use of health-related knowledge portfolio tasks. The author discovered that the students lacked strong content knowledge; for example, more than 50% of the third to sixth grade students were unable to list four aerobic activities. Brusseau, Kulinna, and Cothran (2011) further examined students' knowledge using similar portfolio tasks with two American Indian communities. Students completed health-related fitness and PA behavior portfolio tasks, and the results indicated that students across all grade levels held many misconceptions and misunderstandings of these concepts. Furthermore, researchers found that only 7% of third grade students were able to describe why PA is important. More recently, Hodges, Hodges Kulinna, and Lee (2014) found that the average score for over 700 suburban fifth graders was under 50% on the PE Metrics (National Association for Sport and Physical Education [NASPE], 2010) PA and fitness test. The evidence on students' lack of knowledge is disappointing given that these findings have been evident for 2 decades (Hopple & Graham, 1995).

Spiegel and Foulk (2006) suggested that knowledge of PA behaviors can be the foundation that encourages people to engage in

more PA throughout their lifetimes. This was found to contain some validity, as other researchers have found that individuals engaging in more activity during leisure time had greater knowledge (Dale, Corbin, & Cuddihy, 1998; DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998). DiLorenzo et al. (1998) discovered that exercise knowledge is one of a few key determinants to students' PA participation. Furthermore, conceptual-based physical education (CPE), a model that teaches health knowledge in the classroom partnered with PA opportunities, has also been found to influence PA patterns positively during leisure time (Dale et al., 1998). More specifically, they reported that after a yearlong CPE program, secondary students significantly increased their PA levels when compared to students with both traditional PE and control students. Therefore, to date the literature has begun to suggest that if students gain additional knowledge, they often engage in more PA. Despite this, little effort has been made to explore the relationship, if any, between knowledge and body composition or aerobic fitness. Therefore, the purpose of this manuscript was to determine if PA patterns (steps counts), aerobic fitness (PACER), or BMI had an effect on the fitness and PA content knowledge of ethnically diverse elementary school children from low-income and inner-city families. It was hypothesized that children who accumulated more steps, had higher PACER scores, and lower BMI would score better on the PE Metrics fitness and PA knowledge test. A secondary purpose was to explore differences on PE Metrics performance by grade and gender.

Method

Participants

Participants were 569 (300 girls, 269 boys) fourth to sixth grade students from three inner-city Title 1 schools. Ninety-four percent of participating youth came from low-income (83% free and 11% reduced lunch) families, and the sample was 86% ethnic minority—63% Hispanic, 14% Caucasian, 7% Pacific Islander, 6% Black, 5% Asian, 3% American Indian, and 2% multiracial.

Instruments

Physical activity and physical fitness knowledge test. SHAPE America endorses the PE Metrics (NASPE, 2010) test, which was

used to examine PA and physical fitness knowledge in this study. The instrument has been suggested as a valid and reliable assessment tool (Dyson & Williams, 2012; Zhu et al., 2011) and has been used in research (Hodges et al., 2014) with this age group. More specifically, the research team used the Standards 3 and 4 fifth grade test that contained 28 multiple-choice questions, of which 15 were randomly selected to fit the time frame for testing the children at the beginning of a physical education class.

Pedometers. PA was measured using Yamax DigiWalker CW600 pedometers (Tokyo, Japan). The devices were worn for 5 school days (Monday through Friday) between the hours of 8 a.m. and 3 p.m. Instruments were worn on the hip at the level of the iliac crest above the knees on the right hip. Classroom teachers, physical educators, and members of the research team ensured that the devices were worn the entire school day.

The pedometers included a 7-day memory that was used to record steps each day of the school week. Yamax DigiWalker models have been shown to provide an accurate recording of steps within $\pm 3\%$ of actual steps (Schneider, Crouter, Lukajic, & Bassett, 2003), and have been shown to be a valid measure of free-living PA (Crouter, Schneider, Karbulut, & Bassett, 2003).

Health-related fitness. BMI was calculated using standard procedures taking a student's weight in kilograms divided by the square of his or her height in meters. Height was measured to the nearest 0.01 m using a portable stadiometer (Seca 213; Hanover, MD, USA), and weight was measured to the nearest 0.1 kg using a portable medical scale (BD-590; Tokyo, Japan). Height and weight were collected in the hallway during each student's physical education class.

Aerobic fitness was measured using the 20-m Progressive Aerobic Cardiovascular Endurance Run (PACER), administered during each student's physical education class. The PACER was conducted on a marked gymnasium floor with background music provided by a compact disc. Each student was instructed to run from one floor marker to another floor marker across a 20-m distance within an allotted time frame. The allotted time given to reach the specified distance incrementally shortened as the test progressed. If the student twice failed to reach the other floor marker, the test was terminated (Meredith & Welk, 2010). The final score was recorded in laps.

Procedures

During three consecutive weeks during the winter of 2015, research team members worked with physical education teachers to collect PACER scores and height and weight during class. Half the class completed the PACER with one research team member, and the other half played a game with the physical education teacher, with students being called out to have their height and weight measured. Approximately halfway through class, the groups switched stations (no order effect was found between students who tested first and students who tested second). During a separate class, members of the research team administered the knowledge assessment test following a specific protocol during which each question and answer was read to the students, with an approximately 20–30-s wait time for each question.

Analyses

BMI, PACER, and pedometer steps were stratified into tertiles of approximately equal number. The preliminary descriptive analysis included running a 2×3 factorial ANOVA test to examine the differences between genders and among grade levels on PA, health-related fitness, and the PE Metrics knowledge test scores. The alpha level was adjusted using the Bonferroni method to account for analysis on multiple dependent variables. The primary analysis consisted of a $3 \times 3 \times 3$ factorial ANOVA test to examine differences among tertiles of BMI, PACER, and pedometer steps on the PE Metrics knowledge scores. A Tukey post hoc test was employed for any statistically significant main effects from the three-way ANOVA. All analyses had an initial alpha level of $p \leq 0.05$ and were carried out using STATA (14.0) statistical software package (College Station, TX, USA).

Results

On average, students scored 38% on the PE Metrics knowledge test. Table 1 highlights the means and standard deviations on the PE Metrics knowledge test (raw score out of 15) by gender, grade level, and tertile groupings for PA and health-related fitness. A statistically significant main effect was found for grade level on knowledge test scores, $F(2, 180) = 3.89$, $p = 0.02$. Tukey post hoc tests revealed that children in Grades 4 and 5 scored higher on the knowledge test

compared to children in Grade 6. A statistically significant main effect was also found for BMI on PA knowledge, $F(2, 180) = 3.64, p = 0.03$. Post hoc tests revealed that children in the high BMI tertile and children in the low BMI tertile scored higher on the PA knowledge test compared to children in the medium BMI tertile. No other main effects were found, but there were trends that children with higher PACER scores and who accumulated higher step counts scored higher on the PE Metrics knowledge test.

Table 1
Knowledge Scores by Gender, Grade, Physical Activity, Aerobic Fitness, and BMI

Category	Knowledge score	SD	95% CI
Gender			
Male	5.69	3.34	5.29, 6.09
Female	5.83	2.84	5.51, 6.15
Combined	5.77	3.06	5.52, 6.02
Grade			
4	6.02	2.99	5.59, 6.45
5	6.07	2.99	5.64, 6.50
6*	4.34	3.10	3.90, 4.78
School Step Counts			
High	5.75	2.68	5.37, 6.12
Medium	5.57	2.98	5.15, 5.99
Low	5.22	2.73	4.83, 5.60
PACER Laps			
High	5.82	3.11	5.38, 6.46
Medium	5.75	3.36	5.27, 6.22
Low	5.41	2.7	5.03, 5.79
BMI			
High	6.31	3.07	5.87, 6.75
Medium*	4.93	2.93	4.72, 5.14
Low	6.13	3.09	5.91, 6.35

*Significantly different when compared to other groups.

Discussion

Similar to children in previous research (Brusseau, Kulinna, & Cothran, 2011; Kulinna, 2004), the children in this study lacked overall content knowledge. In fact, the average score was 38.5%. These scores are lower than those in the previous study in which PE Metrics was used (Hodges et al., 2014) and indicate lower knowledge when compared across other studies (Hopple & Graham, 1995; Kulinna, 2004). These scores are concerning, especially considering the lack of PA in low-income inner-city youth (Trost et al., 2013).

Although we know that PA decreases with age and grade, we anticipated that as students advanced in grade, they would have performed better on the knowledge test simply by accumulating more knowledge over time. We found that fourth and fifth graders performed similarly on the test and sixth graders scored significantly lower compared to the earlier grades, which we believe might be related to the sixth graders feeling they were “too cool” to take the test and not taking it as seriously as the younger students did. There were no significant differences by gender, which is similar to results in previous research (Brusseau, Kulinna, & Cothran, 2011). This is important because the literature (Harmon, Brusseau, Collier, & Lenz, 2013) makes it clear that inner-city ethnic minority boys at this age are more active than girls. Furthermore, boys outperformed girls on the PACER, which correlates to previous studies of aerobic fitness in at-risk youth (Brusseau, Finkelstein, Kulinna, & Pangrazi, 2014). It appears as if knowledge does not help to alleviate the natural gender difference in PA or aerobic fitness, as boys were more active and fit in the current sample (5,194 steps and 40.3 PACER laps for boys; 4,498 steps and 34.4 PACER laps for girls; $\Delta = 696$ steps, $\Delta = 5.9$ laps). Our findings suggest that knowledge is not dependent on either grade or gender. It is important to note that these three schools did not offer any type of health education and that this content (health-related fitness and PA) was not directly covered in academic subjects, although science classes did cover material related to the health of the human body. Furthermore, physical education was a traditional model that only met 1 day/week. Because of the time constraints, the physical education paraprofessionals focused exclusively on trying to get children active during class. Another potential issue is that classes were taught by paraprofessionals. Research has started to in-

dicating that classes taught by nonspecialists result in less PA (Hannon, Destani, McGladrey, Williams, & Hill, 2013) and in more time managing children (Hall, Larson, Heinemann, & Brusseau, 2015). It appears to be important for schools (especially inner-city schools) to find a way to incorporate content knowledge related to PA and fitness.

Of importance to our findings were the small (but not significant) trends that the more active the child, the better he or she performed on the knowledge test. We anticipated these findings; however, we would have expected a much larger change score. Out of 15 questions, the difference between the low active group and the high active group was only a half question. These findings contradict the previous explorations, suggesting increased knowledge is related to significantly increased PA (i.e., DiLorenzo et al., 1998).

Similar to the step count trends with knowledge, knowledge slightly increased with increases in PACER laps. This change again was small, < .5 question. To our knowledge, this is the first study to look at differences in fitness content knowledge in comparison to actual aerobic fitness. Aerobic fitness is an important component for the health (Janssen & LeBlanc, 2010) and the cognition (Chaddock-Heyman, Hillman, Cohen, & Kramer, 2014) of children, and we suggest that improved knowledge of this concept can only help with changing the needed behavior.

Body composition did not relate to increases in knowledge, which differs from the role that body composition has in the literature in which both PA (Brusseau, Kulinna, Tudor-Locke, et al., 2011) and physical fitness (Stratton et al., 2007) improve when children's BMI decreases. This might be associated with the overall increases in BMI (Ogden, Carroll, Kit, & Flegal, 2012) in youth and the concept that youth can be fat and fit (Hainer, Toplak, & Stich, 2009).

Future research needs to replicate our work with children from different ethnic and socioeconomic backgrounds to help make the findings more generalizable. Similarly, it is clear that content knowledge needs to be targeted in research and practical programming in schools to address the concerning findings of our work.

Conclusion

In conclusion, at-risk inner-city children in this sample lacked PA and fitness knowledge. Although the lack of knowledge is not new, the low scores compared to those in previous research is especially alarming considering that these children often lack the access and opportunity to become physically active, which have been consistently shown as barriers to activity (Sallis, Prochaska, & Taylor, 2000). Increased opportunities for PA and improved knowledge should be considered when planning future interventions.

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