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# PHYSICAL ACTIVITY OUTCOMES DURING HOPSPORTS PARTICIPATION

Submitted on behalf of the Be Active-Appalachian Partnership  
and Be Active NC

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## **ABOUT THE BE ACTIVE-APPALACHIAN PARTNERSHIP**

The Be Active-Appalachian Partnership was launched in July 2005 at Appalachian State University in Boone. Made possible by a grant from Blue Cross and Blue Shield of North Carolina and housed in the University's Institute for Health and Human Services, the Partnership formalizes a collaborative relationship between Be Active North Carolina, Inc. and Appalachian State University. The mission of the Partnership is to promote physical activity and lifelong fitness for the citizens of western North Carolina.

Through collaboration with local community organizations, the Partnership's strategic goals are:

1. To initiate and implement physical activity programming in western North Carolina by partnering with community organizations and agencies;
2. To effectively brand the Partnership and key physical activity messaging;
3. To contribute to the advancement of knowledge through research;
4. To enhance faculty and student service-learning opportunities.



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## EXECUTIVE SUMMARY



Three-hundred and eighty seven youth from three NC schools participated in an assessment of physical activity outcomes using the HOPSports physical education system (HOPS). Students in grades 4-8 participated in traditional physical education class sessions and in physical education classes using the HOPSports system. Youth's physical activity levels were recorded daily using accelerometers. Accelerometers are small electronic devices worn on an elastic belt that records students' bodily movement in all horizontal vectors (i.e. movement forward, backward, side to side).

Statistical analyses of the participants' activity levels indicated that students were significantly more active, on average, during days when HOPS was used than when it was not used. However, upon comparing HOPS activities with similar non-HOPS activities, no differences were found between HOPS users and non-HOPS users participating in traditional

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sports and no consistent trends were found between those using HOPS and those using DDR for dance activities. When the effects of school grade, gender, race/ethnicity and body mass index were considered independently, girls and students in grades 7 and 8 had significantly greater increases in physical activity when HOPS was used compared to boys and younger participants. However, students in lower grades and those with healthy body weights were more active during HOPSports than older students and students who were overweight or obese.

Broadly, HOPSports appears to be an effective means of promoting moderate to vigorous physical activity among youth. However, results of this study do not provide overwhelming evidence that it exceeds the performance of similar activities provided in non-HOPS PE classes. The most significant value of HOPSports may be in its provision of a variety of relatively easy to facilitate activity lessons and its diverse offerings of programs, some of which PE instructors may not feel comfortable teaching or modeling. We recommend additional research to understand the efficacy of the HOPSports system in high school students, assessment of individual HOPS modules not adopted in this study, and longitudinal research to determine the effects of novelty which may reduce following continued use.

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## INTRODUCTION

Approximately 30 schools and community sites in North Carolina were selected to participate in an assessment of HOPSports technology (HOPS). This assessment was designed as a pilot study to provide information about youth's enjoyment of the HOPS system, learning outcomes achieved with the HOPS system, ease of use of the HOPS system, and how HOPS may or may not enhance the quality of students' physical education.

In addition to participation in this state-wide assessment, three schools in NC were selected to participate in an additional physical activity outcomes assessment of HOPS. The physical activity assessment, like the broader study, was sponsored by Be Active NC and the Be Active-Appalachian Partnership and ran concurrent with the broader statewide pilot study. The purpose of the additional physical activity assessment was to be able to compare the physical activity outcomes of students using HOPS with those who did not use HOPS (that is, they participated in a more traditional form of PE) during their physical education (PE) classes. Essentially, this information tells us whether students were more physically active in PE classes when they were using HOPS. Further, results from this additional study allow us to understand which modules of the HOPS system generate the most physical activity for students in different grades, for boys versus girls, and for students with different body compositions (normal versus overweight students).

As such, the specific research objectives addressed by this study were:

1. Was there a significant difference in the amount of moderate to vigorous physical activity (MVPA) achieved by students when they did use HOPS and when they did not use HOPS?
2. Was there a significant difference in the amount of MVPA achieved by boys versus girls when using HOPS?

- 
3. Was there a significant difference in the amount of MVPA achieved using HOPS according to participant grade?
  4. Was there a significant difference in the amount of MVPA achieved using HOPSports according to participant race/ethnicity?
  5. Was there a significant difference in the amount of MVPA achieved using HOPSports according to participant body mass index?

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## METHODOLOGY

### *Description of Study Participants*

To begin, it is important to understand the range of students who were involved in this HOPS Activity Outcomes research study. Students from the three study sites ranged from 8 to 16 years with most children ages 10-13. A total of 387 students completed assent forms, returned parental consent forms and participated in the HOPS Activity Outcomes research study: 76 youth at West Lenoir Elementary School participated; 65 middle-school students from Cane Creek Middle School participated; and 265 youth at Central Wilkes School participated. More girls (54%) participated in the study than boys (46%) and substantial racial and ethnic diversity was achieved, particularly among younger study participants. While almost two-thirds of the sample was Caucasian, one in six students was Hispanic non-white, and another 13.4% of students were African American. Each child's age, gender, weight and height were used to derive a body mass index score using classifications developed by the Centers for Disease Control for youth under age 18. Students were then put into one of three categories using the BMI-for-age Percentile Growth Chart also developed by the Centers for Disease Control: 1) healthy weight; 2) at risk of being overweight; and 3) overweight/at-risk of being obese. Of the almost 400 student participants, 55% of participants were of normal weight, 24% were at risk for being overweight and 21% were at risk of being obese. See Table 1 and Figures 1-5.

TABLE 1  
Demographic Characteristics  
of Study Participants

	Percentage (N = 387)
Age	
9	5.1
10	8.7
11	35.2
12	21.9
13	21.1
≥14	8.0
Grade	
4	9.5
5	10.0
6	35.0
7	23.9
8	21.6
Gender	
Male	46.3
Female	53.7
Race/Ethnicity	
African-American	13.4
Hispanic (non-white)	14.7
Caucasian	63.2
Multi-race/ethnicity	2.8
Other	5.9
Body Mass Index	
Healthy Weight	54.8
At risk of overweight	23.9
Overweight/ At risk of being obese	21.3



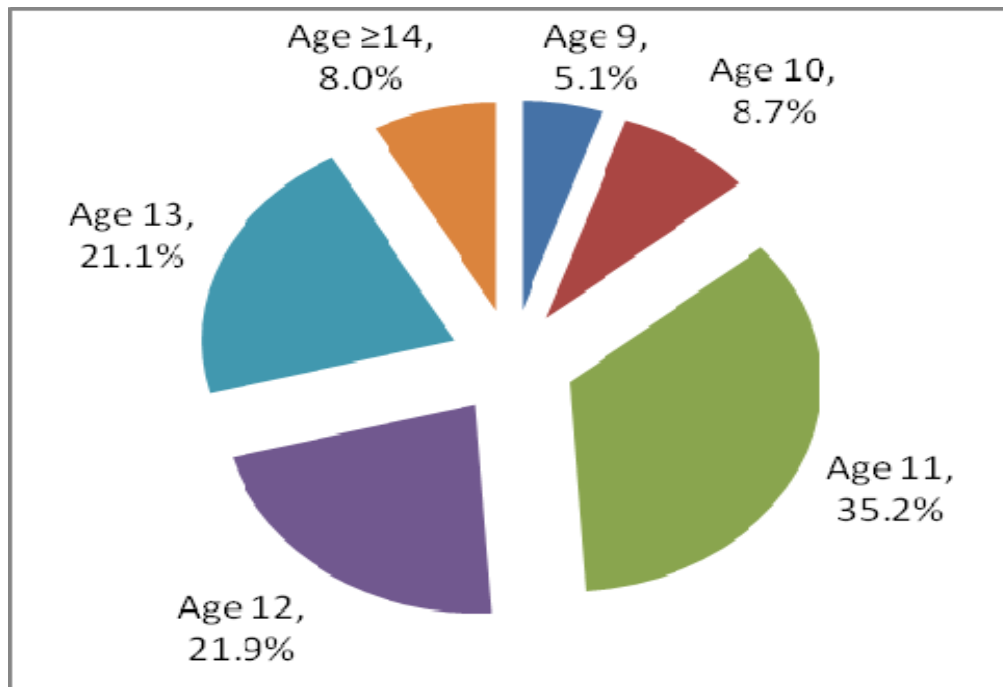


FIGURE 1  
Breakdown of Study Participants Based on Age

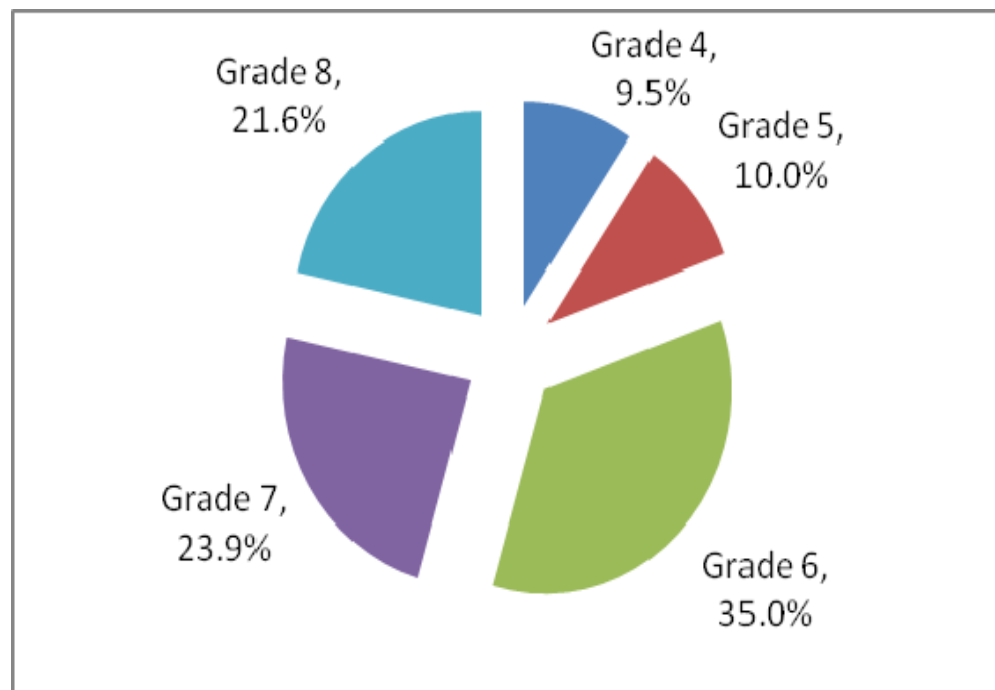


FIGURE 2  
Breakdown of Study Participants Based on Grade Level

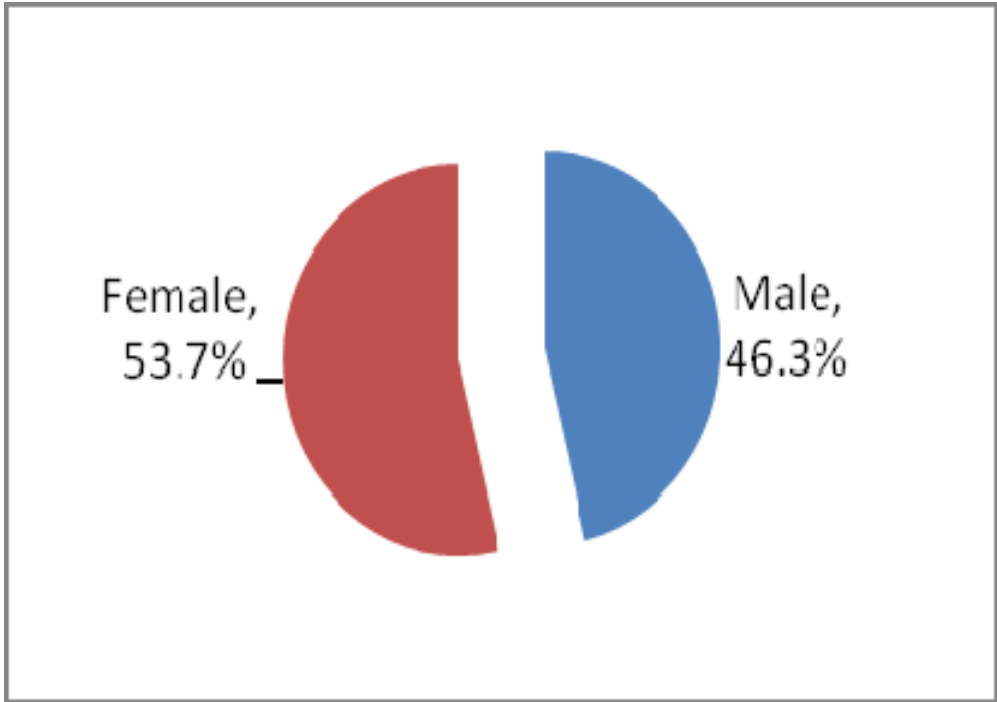


FIGURE 3  
Breakdown of Study Participants Based on Gender

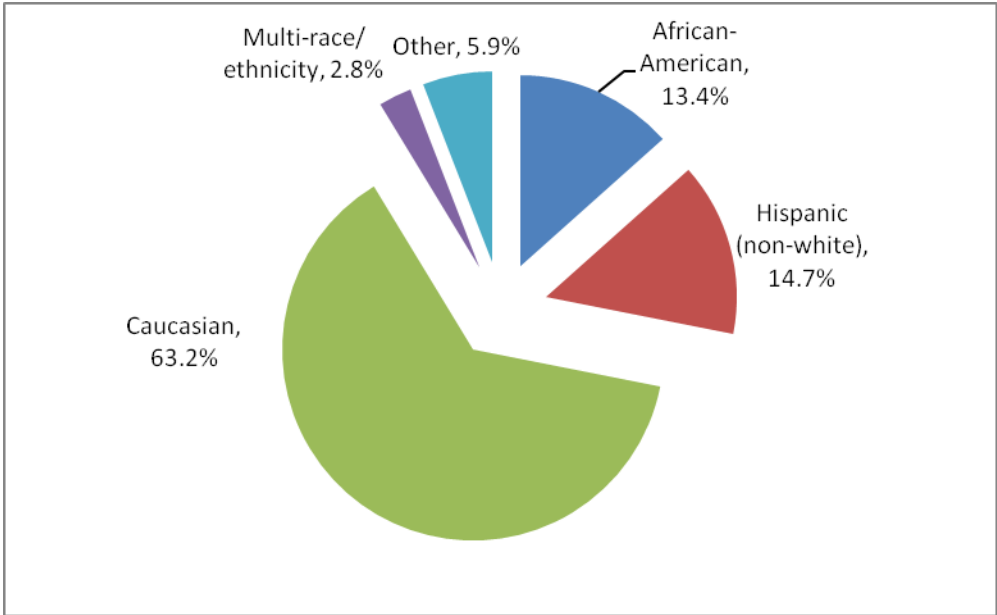


FIGURE 4  
Breakdown of Study Participants Based on Race/Ethnicity

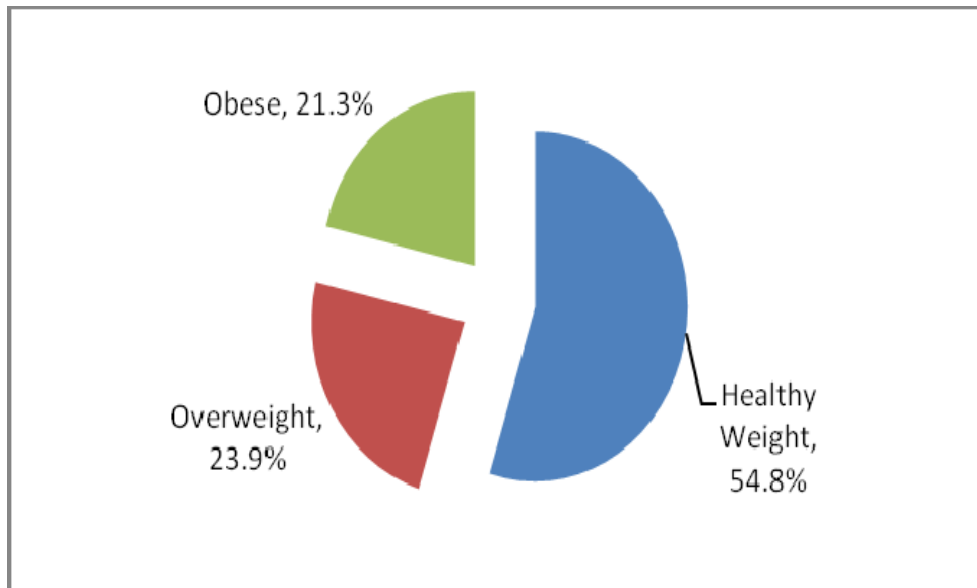


FIGURE 5  
Breakdown of Study Participants Based on Body Mass Index

#### *Data Collection*

To measure students' physical activity levels, schools were provided with Actigraph GT1M physical activity monitors (aka accelerometers) for students to wear during physical education classes. See Figure 6. The teachers in this study instructed students to wear the activity monitor above their left hip for two weeks of PE class *when they were not using HOPS* and for two weeks of PE class *when they were using HOPS*. These activity monitors are small electronic devices which look similar to a pedometer and are worn on an elastic belt around the waist. When wearing the device, bodily movement is measured in all horizontal vectors (i.e. movement forward, backward, side to side) and digitally stored to be downloaded later onto a personal computer using a USB cord. Thus, for each student, the Actigraph activity monitor captures and saves their amount of physical activity.



FIGURE 6  
The Actigraph GT1M Accelerometer  
Image courtesy of [www.theactigraph.com](http://www.theactigraph.com)

Actigraph activity monitors provide a raw “count” value in the way that a pedometer provides a step count. Although this raw value makes little sense alone, a calculation involving the student’s gender, age and weight allows researchers to determine the amount of work done by the student and the metabolic equivalent (METs) of physical activity in which they participated. As such, the physical activity outcome provides information on the number of minutes youth spent in sedentary, light, moderate, and vigorous physical activity while using HOPS and without HOPS (Troost et al., 2002). This information allowed us to test the efficacy of HOPS for increasing students’ physical activity intensity during PE class.

## RESULTS

Results from the research objectives are presented individually. However, Table 2 provides a summary of the research questions asked and answered in this study.

TABLE 2  
A Summary of Statistical Tests and Observed Outcomes

Comparison	Research Question	Statistical Test	Findings
Overall: HOPS vs. traditional PE	Was there a significant difference in the amount of moderate to vigorous physical activity (MVPA) achieved by students when they did use HOPS and when they did not use HOPS?	Repeated measures ANOVA Test statistic: $F = 10.11$ Significance value: $p < .01$	Youth were significantly more active on average during days when HOPS was used in the classroom than when it was not used.
Sports: HOPS vs traditional PE	Was there a significant difference in the amount of MVPA achieved by students participating in “traditional sports” using HOPS and those in non-HOPS classes?	ANOVA Test statistic: $F = 1.12$ Significant value: Not significant	Significant statistical differences were not observed in the amount of MVPA undertaken during non-HOPS PE sports play (all sports) and when sports were undertaken with the HOPSports system (all sports).
Dance: HOPS vs. other dance technology	Was there a significant difference in the amount of MVPA achieved by students participating in dance-based HOPS modules and those using DDR in a non-HOPS class?	Repeated Measures ANOVA Test statistic: $F = 14.35$ Significant value: $p < .01$	When students participated in Dance Dance Revolution (Non-Hops) and Hip Hop Dance (HOPSports) they recorded significantly more MVPA than when participating in Break Dancing (HOPSports).
Gender: HOPS vs. traditional PE	Was there a significant difference by gender in the amount of moderate to vigorous physical activity (MVPA) achieved by students when they did use HOPS and when they did not use HOPS?	Repeated Measures ANOVA Test statistic: $F = 23.40$ Significance value: $p < .01$	While both girls and boys increased physical activity levels using the HOPS system, HOPSports had a significantly greater impact on girls’ activity levels than boys.

Gender: When using HOPS	Was there a significant difference in the amount of MVPA achieved by boys versus girls when using HOPS?	Analysis of Covariance with school, grade, race/ethnicity, BMI entered as covariates Test statistic: $F = 2.14$ Significance value: Not significant	When other factors known to impact physical activity levels were taken into consideration, we found that boys and girls had similar levels of activity when HOPSports was used in the classroom. Typically boys are more physically active than girls at this age. When using HOPS, this was not the case in our sample.
Grade level HOPS vs. traditional PE	Was there a significant difference by grade level in the amount of moderate to vigorous physical activity (MVPA) achieved by students when they did use HOPS and when they did not use HOPS?	Repeated Measures ANOVA Test statistic: $F = 19.22$ Significance value: $p < .05$	While students in all grades increased physical activity levels using the HOPS system, HOPSports had a significantly greater impact on the activity levels of students in 7 <sup>th</sup> and 8 <sup>th</sup> grade.
Grade level: When using HOPS	Was there a significant difference in the amount of MVPA achieved using HOPS according to participant grade?	Analysis of Covariance with school, gender, race/ethnicity, BMI entered as covariates Test statistic: $F = 8.91$ Significance value: $p < .01$	When other factors known to impact physical activity levels were taken into consideration, students in younger grades were more active using HOPS than students in older grades. Thus, while older students gained more MVPA than younger students using HOPS (see above) students in lower grades were still more active than those in higher grades.
Race/ethnicity: HOPS vs. traditional PE	Was there a significant difference by race/ethnicity in the amount of moderate to vigorous physical activity (MVPA) achieved by students when they did use HOPS and when they did not use HOPS?	Repeated measures ANOVA Test statistic: $F = 1.99$ Significance value: Not significant	Students of all race/ethnicities in this sample had statistically similar gains in MVPA when using HOPSports.
Race/ethnicity: When using HOPS	Was there a significant difference in the amount of	Analysis of Covariance with school, gender, grade, BMI entered as	When other factors known to impact physical activity levels were taken into

	MVPA achieved using HOPSports according to participant race/ethnicity?	covariates Test statistic: $F = 1.94$ Significance value: Not significant	consideration, students of different races and ethnicities had similar levels of activity when Hop Sports was used in the classroom.
BMI: HOPS vs. traditional PE	Was there a significant difference by BMI in the amount of moderate to vigorous physical activity (MVPA) achieved by students when they did use HOPS and when they did not use HOPS?	Repeated measures ANOVA Test statistic: $F = 3.65$ Significance value: Not significant	There was no significant difference in the size of the activity increase according to BMI level. While HOPSports increased activity levels for students with all BMI classifications, the HOPS participation gap between the most active students with healthy weights and the less active students who were overweight or obese was insignificant.
BMI: When using HOPS	Was there a significant difference in the amount of MVPA achieved using HOPSports according to participant body mass index?	Analysis of Covariance with school, gender, grade, race/ethnicity entered as covariates Test statistic: $F = 5.20$ Significance value: $p < .05$	When other factors known to impact physical activity levels were taken into consideration, students with healthy weights (determined by their BMI) were more active using HOPS than students who were overweight or obese. However, the difference in MVPA between individuals with healthy weights and those who were overweight or obese was smaller when HOPS was used in PE class than when it was not used.

### *Comparing Activity Levels of Youth Using HOPSports with Traditional PE Participation*

To begin, students' levels of moderate to vigorous physical activity (MVPA) achieved using HOPS were compared with those obtained in traditional PE classes. Findings from a repeated measures analysis of variance (RMANOVA) indicate that on average, students spent a greater proportion of their class time in MVPA when HOPS was used than when traditional PE

lessons were undertaken (See Table 3). During non-HOPS class periods, students, on average, participated in sedentary activity for 36% of the class period, were involved in light activity 26% of the time, and engaged in moderate physical activity 34% of the time. Only 4% of non-HOPS class periods, on average, were spent in vigorous physical activity. However, when HOPS was used in the classroom for traditional sports, students spent only 23% of their time in sedentary activities, while 18% of their time was spent in light intensity activities and 59% of the class period was spent in moderate and vigorous physical activity. Because most class periods lasted approximately 40 minutes, approximately 15 minutes of traditional PE class periods were spent in MVPA. In contrast, 23.6 minutes were spent in MVPA (a greater than 50% increase) when HOPSports was used. This means that when HOPSports was used in classrooms students received an average of 8.6 minutes of additional minutes of MVPA per class meeting! Extrapolated across the 220 days in the North Carolina school year, with classes meeting twice weekly, students would receive a projected 12.6 additional hours of MVPA each school year.

TABLE 3  
A Comparison of the Activity Intensities of HOPS and Non-HOPS Class Periods

	Non-HOPS (1,417 cases)		HOPS (1,020 cases)	
Sedentary < 1 MET	36%	14 m, 24s	23%	9 m, 12s
Light 1-3 METS	26%	10 m, 24s	18%	7 m, 12s
Moderate 3.01-6 METS	34%	13 m, 36s	48%	19 m, 12s
Vigorous >6 METS	4%	1 m, 36s	11%	4 m, 24s

Note: Values describe the percentage of the lesson in which students were active at each of four intensities. Minutes and seconds describe the length of time students spent in each of four activity intensities for a 40 minute class period). Raw Actigraph counts were transformed to

activity intensity using an adaptation of Freedson's equation (aka Trost's 30-second epoch cut-points) where  $METs = 2.757 + (.0015 * \text{counts/min} - 1) - (0.08957 * \text{age}) - (0.000038 * \text{counts/min} - 1 * \text{age})$ .

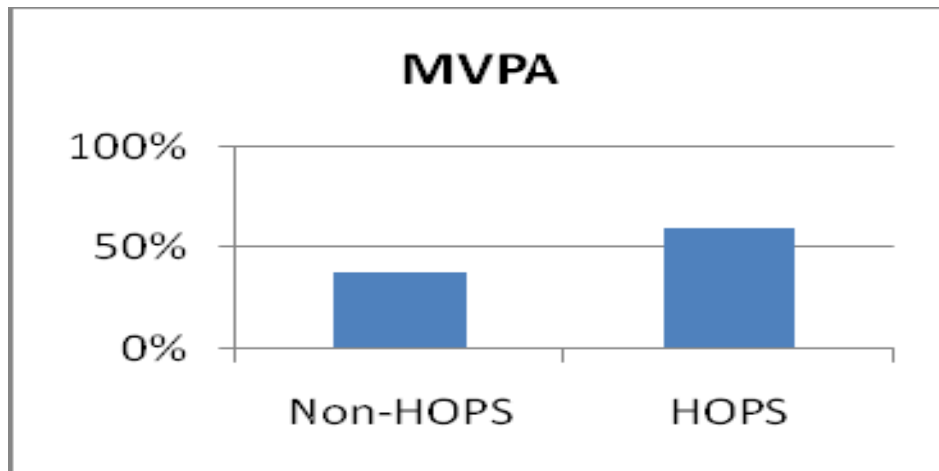


FIGURE 7

A Comparison of the Moderate and Vigorous Physical Activity Levels of HOPS and Non-HOPS Class Periods

Having found a significant difference among activity intensities based on whether students were participating in HOPS or non-HOPS PE classes, a comparison of activities performed by the students led to two additional research questions:

1. Was there a significant difference in the amount of moderate to vigorous physical activity (MVPA) achieved by students participating in “traditional sports” using HOPS and those in non-HOPS classes?
2. Was there a significant difference in the amount of MVPA achieved by students participating in dance-based HOPS modules and those using DDR in a non-HOPS class?

Using an ANOVA, no significant statistical differences were observed in the amount of MVPA undertaken during sports play in non-HOPSsports PE classes (badminton and basketball) compared to when sports were undertaken with the HOPSsports system (volleyball, baseball, golf

and hockey). See Table 4. Sports included in the analysis were those undertaken by one of the three sites during the study period. The researchers acknowledge that these findings are limited given: 1) the flexibility given to the instructor to choose the HOPS or non-HOPS activities in which their classes participated each day, and 2) the relatively short length of time and, therefore, the limited number of associated PE classes during which the study was held.

TABLE 4  
A Comparison of Activity Levels for Youth Engaged in Traditional Sports Using HOPS with Non-HOPS PE Classes

	Non-HOPSports			HOPSports Sports Modules				All Sports
	Badminton	Basketball	All Sports	Volleyball	Baseball	Golf	Hockey	
Sedentary	31%	29%	30%	32%	25%	29%	27%	28%
Light < 3 METS	42%	22%	30%	31%	35%	29%	29%	32%
Moderate 3.01-6 METS	26%	41%	36%	33%	35%	39%	42%	36%
Vigorous >6 METS	1%	8%	4%	4%	5%	3%	6%	4%

Note: Results from the two study sites (Cane Creek and Central Wilkes) that engaged in sports activities.

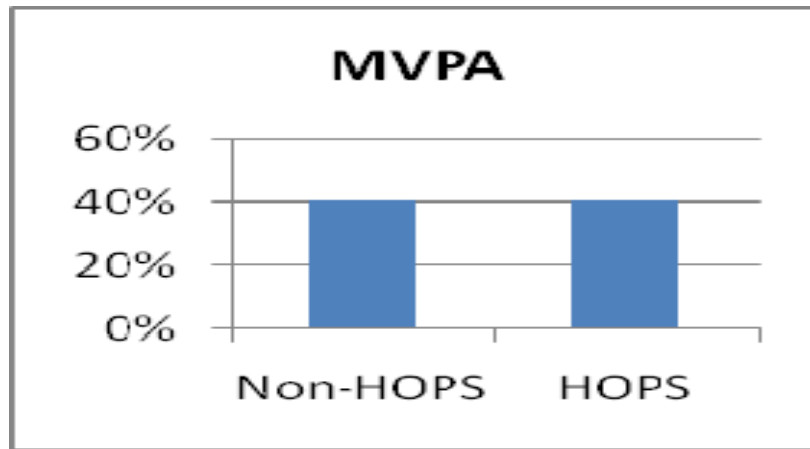


FIGURE 8  
A Comparison of Moderate and Vigorous Physical Activity Levels for Youth Engaged in Traditional Sports Using HOPS with Non-HOPS PE Classes

As DDR is often a component within a comprehensive Physical Education program, researchers compared the abilities of DDR with HOPS to promote MVPA. The 40 students from Cane Creek Middle School served as the sample population for this portion of the study. As is typical for the implementation of DDR in a PE class, two students used the DDR dance pads for each song while the other students participated in “shadow DDR’ing.” In the case of shadow DDR’ing, students who are not on the dance pads try to follow the dance steps prescribed by the DDR system without any electronic feedback. Meanwhile, the two students on the dance pads are provided electronic feedback on their ability to correctly match the prescribed dance steps. At the end of each song, students rotate so that each student has the opportunity to be evaluated (i.e. scored) by the DDR system.

Although no significant difference was observed in the analysis of traditional sports, significant differences were detected between Dance Dance Revolution (DDR) and dance related HOPS modules. Results from a repeated measure ANOVA indicated significant differences in the amount of MVPA between the two activities for the 40 students who participated in both

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activity groups. The findings, though, did not favor HOPS or non-HOPS over the alternative. Instead, when students participated in Dance Dance Revolution (Non-HOPS) and Hip Hop Dance (HOPSports) they recorded significantly more MVPA than when participating in Break Dancing (HOPSports). Therefore, no conclusions can be drawn as to the superiority of HOPSports compared to Dance Dance Revolution. See Table 5 for a summary of activity intensity according to dance modules undertaken.

TABLE 5  
A Comparison of Physical Activity Levels for HOPS and Non-HOPS Technology Based Dance Instruction

	Non-HOPSports	HOPSports Dance Modules	
	Dance Dance Revolution	Hip Hop Dance	Break Dance
Sedentary	22%	27%	32%
Light < 3 METS	29%	25%	28%
Moderate 3.01-6 METS	55%	56%	37%
Vigorous >6 METS	9%	7%	3%

Note: Results drawn from the one study site (Cane Creek) that engaged in multiple dance activities.

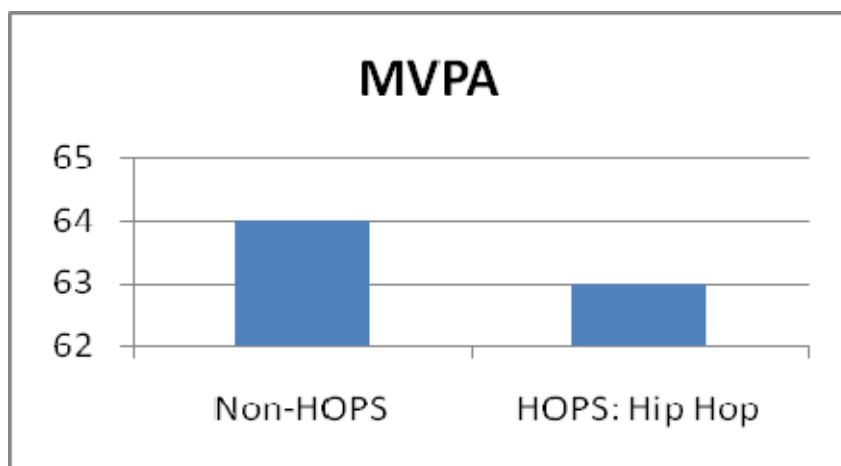


FIGURE 9  
A Comparison of Moderate and Vigorous Physical Activity Levels for HOPS and Non-HOPS Technology Based Dance Instruction

*Comparing the Achievement of Moderate-to-Vigorous Physical Activity Levels by HOPSports Users by Gender, Grade, Race/Ethnicity and Body Mass Index*

In this section we seek an understanding of which sub-sets of the student population have the most to gain from using the HOPS system. Although on average, students achieved more

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physical activity when HOPS was used than during traditional PE sessions, analysis of the efficacy of the system for different sub-groups of students remains. To this end, we investigated whether the system was equally effective for students of different genders, in different grades, and reporting different race/ethnicities and body mass indices. Student activity levels were analyzed in two ways. First, we examined whether the HOPSports system provided statistically similar increases in MVPA according to personal characteristics. A repeated measures analysis of variance (RMANOVA) was conducted for each of four personal factors (gender, grade level, race/ethnicity, BMI) which may be related to a student's response to the HOPS system. For example, results indicate whether boys or girls experienced significantly greater physical activity impacts from HOPS. Second, we turn our attention to only those class periods dedicated to instruction using HOPSports. Student activity levels were analyzed to understand how the HOPS system may differentially affect students according to their gender, grade, race/ethnicity, and body mass index. To address each objective, an analysis of covariance (ANCOVA) was undertaken to test for significant differences in physical activity intensity according to the variable of interest. For example, to examine whether a student's gender was significantly related to the proportion of time that student spent in sedentary, light, moderate, and vigorous physical activity, gender was entered as the independent variable and activity intensity was entered as the dependent variable. Given that other demographic variables may impact activity outcomes using HOPS, grade, race/ethnicity, and body mass index were entered as covariates. Only main effects are reported.

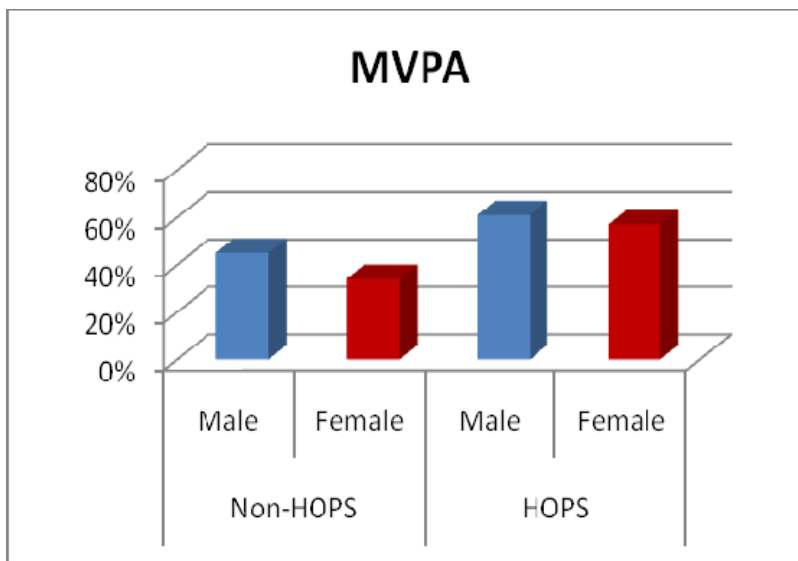


Gender: When HOPS was used in place of traditional PE both boys and girls logged significant increases in their physical activity levels. However, results from the RMANOVA indicate a statistically significant difference in MVPA increase according to gender (RMANOVA  $F = 23.40$ ,  $p < .01$ ). Girls had a significantly greater increase than boys in MVPA using HOPSports. Girls increased their participation in MVPA from 31% of the class period (12.4 minutes) to 46% of the class period (18.4 minutes) while boys increased their participation of MVPA from 36% of the class period (15.2 minutes) to 48% of the class period (19.2 minutes). Higher increases by girls resulted in statistically similar levels of MVPA during HOPS participation (ANCOVA  $F = 2.14$ , Not significant). Whereas boys were significantly more active during traditional PE sessions, boys and girls had similar activity levels during HOPSports participation. These findings are particularly encouraging since research has consistently demonstrated that boys are increasingly more active than girls as they enter adolescence. Results suggest that the HOPS system may be a mechanism to bridge the gap between boys' and girls' physical activity intensities that often occurs when youth reach adolescence.

**TABLE 6**  
The Proportion of Class Time Spent in Each of Four Activity Intensities According to Participant Gender

	Non-HOPS		HOPS	
	Male	Female	Male	Female
Sedentary	32%	35%	20%	24%
Light < 3 METS	23%	31%	19%	19%
Moderate 3.01-6 METS	38%	31%	48%	46%
Vigorous > 6 METS	7%	3%	13%	11%

Note: Raw Actigraph counts were transformed to activity intensity (sedentary, light, moderate or vigorous) using an adaptation of Freedson’s equation (aka Trost’s 30-second epoch cut-points) where METs = 2.757 + (.0015 \* counts/min - 1) – (0.08957\*age) – (0.000038\*counts/min-1\*age).



**FIGURE 10**  
The Proportion of Class time in Moderate and Vigorous Physical Activity According to Participant Gender

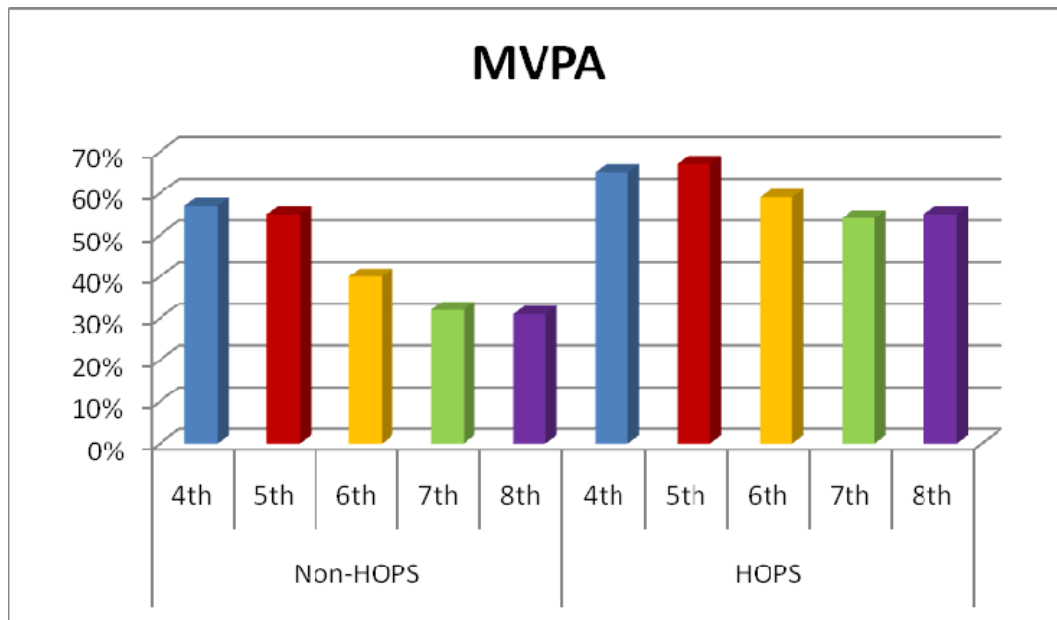
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*Grade:* RMANOVA results indicated significant increases in MVPA for students in all grades when HOPS was adopted in the classroom. However, students in grades 7 and 8 had a statistically greater increase in MVPA than students in younger grades ( $F = 19.22, p < .05$ ). As shown in Table 7, 4<sup>th</sup> graders engaged in MVPA for 65% of the class period when HOPS was used compared to 57% of the class period during traditional PE sessions. Fifth graders increased the proportion of class time in MVPA by 17%, while 6<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> graders increased their time in MVPA by 19%, and 22, and 23% respectively. An examination of MVPA levels during HOPSports lessons identified statistically significant differences in according to grade level during HOPS session ( $F = 8.91, p < .01$ ). In this case, students in younger grades were significantly more active than students in older grades during HOPSports sessions. We can conclude that, for our sample, youth in all grades were significantly more active during HOPSports sessions than without HOPS and youth in older grades made greater increases in MVPA using HOPS than did the youngest participants. That said, younger children remained more active than older children irrespective of the teaching technique adopted. This last finding was expected given that a substantial volume of empirical research has demonstrated youth activity levels decline as age advances (Berkey et al., 2000; Bradley, McMurray, Harrell, & Deng, 2000; Michael I. Goran, Gower, Nagy, & Johnson, 1998; M. I. Goran, Reynolds, & Lindquist, 1999; Kohl, Fulton, & Caspersen, 2000; Mota & Esculcas, 2002).

**TABLE 7**  
**The Proportion of HOPS and Non-HOPS Achieved During Class Periods in Four Activity Intensities According to Participant Grade**

	Non-HOPS					HOPS				
	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>
Sedentary	19%	23%	34%	37%	37%	17%	16%	23%	25%	26%
Light < 3 METS	24%	22%	26%	31%	32%	18%	17%	20%	21%	19%
Moderate 3.01-6 METS	41%	40%	36%	29%	28%	49%	53%	47%	45%	47%
Vigorous >6 METS	16%	15%	4%	3%	3%	16%	14%	12%	9%	8%

Note: Values describe the percentage of the lesson in which students were active at each of four intensities. Raw Actigraph counts were transformed to activity intensity using an adaptation of Freedson’s equation (aka Trost’s 30-second epoch cut-points) where METs = 2.757 + (.0015 \* counts/min - 1) – (0.08957\*age) – (0.000038\*counts/min-1\*age).



**FIGURE 11**  
**The Proportion of HOPS and Non-HOPS Achieved During Class Periods in Moderate and Vigorous Physical Activity According to Participant Grade**

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Race/Ethnicity: Students of different race/ethnicities had statistically similar increases in MVPA when using HOPSports in place of traditional PE sessions (RMANOVA  $F = 1.99$ , not significant). Further, no significant difference in the amount of MVPA achieved using HOPSports was observed according to race/ethnicity when controlling for age, school site, and body mass index (ANCOVA  $F = 1.94$ , not significant). Thus, on average, students of all race/ethnicities increased their MVPA levels using HOPS, albeit at the same rate.

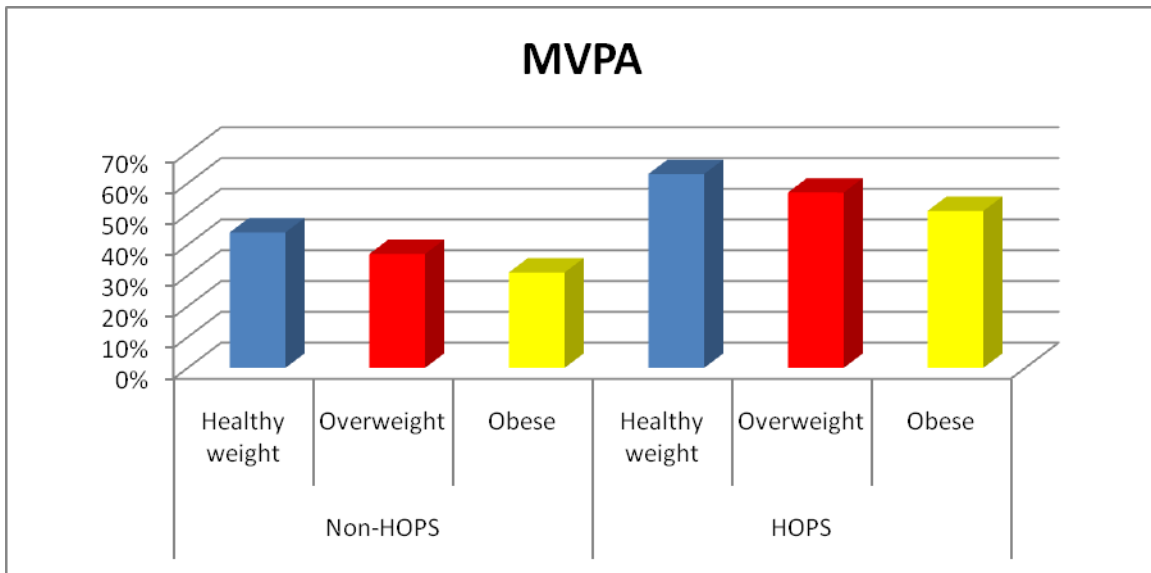
Body Mass Index: Using the Centers for Disease Control guidelines for body mass index which accounts for children's age, gender, height and weight, body mass index was calculated. Based on students' resultant scores, standards from the Centers for Disease Control can then be used to identify students as having a healthy weight, being at risk of being overweight, or at risk of being obese. As described earlier, on average all students increased their activity level when HOPS was used during class. RMANOVA results indicate that there were no differences according to BMI in the efficacy of the HOPSports intervention. Each BMI grouping experienced statistically similar increases in their MVPA when HOPSports was used in the classroom ( $F = 3.65$ , not significant). However, students' activity intensities during HOPSports sessions were significantly different according to body mass index (ANCOVA  $F = 5.20$ ,  $p < .05$ ). Statistical analysis indicated that students who were at risk of being obese were significantly less active in MVPA using HOPSports than students classified as at risk of being overweight or having a healthy weight. Similarly, students who were at risk of being overweight were significantly less active in MVPA than students at a healthy weight. All students had similar amounts of sedentary behavior when using the HOPS system. Overall, findings demonstrate that HOPSports increased activity levels of students with all body mass indexes, but did not reduce the gap between the

most active students with healthy weights and the less active students who were overweight or obese.



**TABLE 8**  
**The Proportion of HOPS and Non-HOPS Achieved During Class Periods in Four Activity Intensities According to Participant Body Mass Index**

	Non-HOPS			HOPS		
	Healthy weight	Overweight	Obese	Healthy weight	Overweight	Obese
Sedentary	35%	36%	36%	21%	22%	23%
Light < 3 METS	21%	27%	33%	16%	21%	26%
Moderate 3.01-6 METS	38%	34%	29%	50%	48%	45%
Vigorous >6 METS	6%	3%	2%	13%	9%	6%



**FIGURE 12**  
**The Proportion of HOPS and Non-HOPS Achieved During Class Periods in Moderate and Vigorous Physical Activity According to Participant Body Mass Index**

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### *Comparing Activity Levels of Youth Using Different HOPSports Modules*

By comparing the activity levels achieved by the use of each module at a particular school, it is possible to identify which modules led to the achievement of the most moderate and vigorous physical activity. See Table 9 and Figure 13 for a comparison of the moderate and vigorous activity levels obtained, on average, during each of the HOPS modules used. This information is provided for only two of the three school sites, as the third site did not provide enough detail for this analysis.

Having identified the moderate and vigorous physical activity levels for each module, the top performing modules were identified among overall users and significantly different categories of users. “Top performing” is designated to describe those modules that led to the largest proportion of in-class time spent at moderate and vigorous intensities. While other modules may not engage students in the same quantity of MVPA, the HOPSports system and physical education instruction list fitness and activity outcomes as only one of several goals. Readers are also cautioned to consider that the top performing modules identified in this study are drawn from a list of only the 25 unique modules used at these two school sites. Currently, HOPSports has over 80 modules with more under production at time of this report.

TABLE 9  
Moderate and Vigorous Physical Activity Levels for Various HOPS Modules Adopted

West Lenoir	West Lenoir	Cane Creek	% MVPA, min
Aerobic/Cardio Kickboxing	X	X	65%, 26 min
Baseball	X	X	40%, 16 min
Boot Camp	X		50%, 20 min
Break Dancing (n=	X	X	40%, 16 min
Buddy Jump		X	58%, 23 min
Buddy Lee Resistance Training	X		53%, 21 min
Cardio Fusion	X	X	55%, 22 min
Cardio Fusion Strength	X		47%, 19 min
Fitness Chapter 1	X		57%, 23 min
Golf	X	X	42%, 17 min
Hip Hop Dance	X		63%, 25 min
Hockey	X		48%, 19 min
Ladder Circuit 1	X	X	60%, 24 min
Luisa Circuit 1 (Spanish)	X		50%, 20 min
Maeve Yoga		X	49%, 20 min
Off Da Hook 2/Hip Hop	X		55%, 22 min
Off Da Hook Lesson 1	X		57%, 23 min
Volleyball		X	37%, 15 min
Warm-up 8 (What Moves You) Circuit	X		45%, 18 min
Warm-up Asthma/Hops Circuit	X		46%, 18 min
Warrior Poses Yoga		X	42%, 17 min

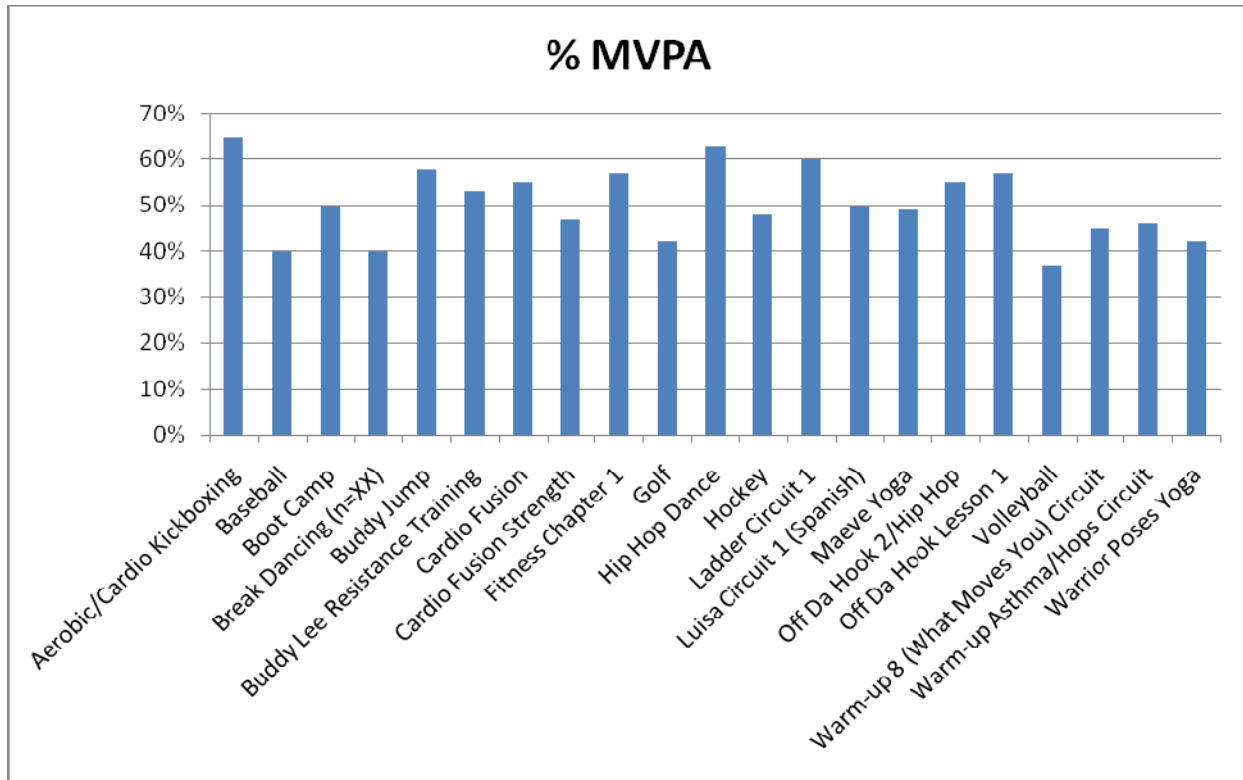


FIGURE 13  
Moderate and Vigorous Physical Activity Levels for Various HOPS Modules

The top three performing modules overall, that is among both schools, were: Cardio Kickboxing, Ladder Circuit 1 and Hip Hop Dancing. Given that significant differences for activity levels obtained were found according to grade, modules were also assessed by grade. The top performing modules among middle school youth, however, were Cardio Kickboxing, Ladder Circuit 1 and Buddy Jump, while for elementary school youth they were Aerobic Kickboxing, Off Da Hook Lesson 1 and Ladder Circuit 1.

As body mass index was also found to have a significant impact on the level of activity achieved by participants, it is also important to consider which modules were most effective for students at risk of obesity. The top performing modules for students with BMIs indicating that the students are at risk for obesity were Cardio Kickboxing, Fitness Chapter 1 and Hip Hop

Dance. See Table 10 for a summary of the top performing HOPS modules overall, as well as those for middle school youth, elementary school youth and students identified as at risk for obesity.

TABLE 10  
Top Performing HOPSports Modules Based on Moderate or Vigorous Physical Activity Levels

	Top Performing HOPS Modules		
	First Highest Performing	Second Highest Performing	Third Highest Performing
Overall	Cardio Kickboxing	Ladder Circuit 1	Hip Hop Dancing
Middle School Youth	Cardio Kickboxing	Ladder Circuit 1	Buddy Jump
Elementary School Youth	Aerobic Kickboxing	Off Da Hook Lesson 1	Ladder Circuit 1
Youth with Obese BMI Scores	Cardio Kickboxing	Fitness Chapter 1	Hip Hop Dance

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## CONCLUSIONS AND IMPLICATIONS OF STUDY FINDINGS

Based on this assessment of 387 students at three different schools, HOPSports (HOPS) was found in several situations to be more effective at improving the amount of time students in PE classes spent in moderate and vigorous physical activity (MVPA) than traditional PE classes. In a comparison of the MVPA achieved by students overall in HOPS and non-HOPS classes, youth were found to be significantly more active, on average, during days when HOPS was used than when it was not used.

When the effects of school grade, gender, grade, race/ethnicity and BMI were considered independently, with the other factors taken into consideration, results varied. Although boys and girls had similar levels of activity while using HOPS in their PE classes, the girls' activity levels had significantly greater increases than boys. Typically, research has shown that boys are more physically active than girls at these ages; however, this was not the case when HOPS was used with our sample. Despite the use of HOPS resulting in significantly greater physical activity levels for older students than younger students, students in younger grades were simply more active than those in older grades. Research on youth activity also supports this finding that physical activity levels decrease with age. Students of different races and ethnicities had similar levels of activity when using HOPS in the classroom and saw similar gains in MVPA using HOPS than when participating in traditional PE. Finally, while students of different BMIs saw similar increases in physical activity from using HOPS, students who were considered to be a healthy weight (based on their BMI) were significantly more active while using HOPS than students who were overweight or obese. However, the difference in MVPA between individuals with healthy weights and those who were overweight or obese was smaller when HOPS was

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used in PE class than when it was not used. Of particular note is that when overweight and obese youth used HOPS, they went from spending 31% of their PE class time in MVPA to 51%.

Given that differences were found, overall, when youth participated in HOPS classes compared to when they did not, the levels of moderate and vigorous physical activity were compared for students in “traditional sports” using HOPS and those not using HOPS. Although the sports could not be compared individually, there were no overall differences. In contrast, a small sub-study of 40 participants revealed differences among users of dance-related HOPS classes and DDR but given that one HOPS module (Break Dancing) was less effective and one was more effective (Hip Hop) at increasing MVPA among youth than DDR, results were inconclusive in deciding which, HOPS dance-related modules or DDR, were more effective.

As with any research study, additional research is needed to more accurately assess the value of HOPSports in a comprehensive Physical Education program. The following research objectives are suggested: 1) Remaining HOPS modules should be tested to ascertain the MVPA levels obtained during each of them; 2) the MVPA of youth engaged in traditional sports beyond those evaluated in this study (for example: soccer, ultimate frisbee and softball) should be measured to allow comparisons between similar HOPS and non-HOPS activities; 3) the MVPA of youth engaged in traditional PE dance classes, including aerobics, should be measured to allow comparisons between dance related HOPS and non-HOPS activities; 4) if HOPSports is being considered for use in high schools, the study should be expanded to include high school students; 5) additional sites should be measured to reduce instructor bias when comparing elementary, middle school and high school participation; 6) the long term effects of HOPSports should be studied to determine whether the amount of moderate and vigorous physical activity remains across time after the novelty of student exposure to the HOPS system and/or individual

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HOPS module; 7) the efficacy of HOPS should be considered compared to hiring activity area specialists, such as a cardio kickboxing or a yoga instructor; and 8) given that the goals of Physical Education extend beyond the achievement of moderate and physical activity, research should also consider the effect of HOPSports on the motor skill development of youth compared to those in non-HOPS classes. In particular, previous research suggests that video modeling without personalized feedback (raise your elbow, bend your knees, etc...) is not more effective than personal instruction at teaching gross motor skills. The opportunity for teachers using HOPS to provide this type of personalized feedback while other students remain engaged in activity seems to provide particular promise for teaching gross motor skills in a group environment.

In conclusion, HOPSports appears to be an effective means of promoting moderate to vigorous physical activity among youth. However, results of this study do not provide overwhelming evidence that it exceeds the performance of similar activities provided in non-HOPS PE classes. Instead, findings appear to suggest that the key to higher levels of moderate to vigorous physical activity levels lie in the choices of activities made by PE instructors. The most significant value of HOPSports may, therefore, be in its provision of a variety of relatively easy to facilitate activity lessons, some of which, such as Hip Hop Dance, PE instructors may not feel comfortable teaching or modeling. In addition, activity lessons like the Circuit Ladders may benefit from the HOPSports system which provides continuous video modeling, upbeat music and verbal cues as part of the lesson. Finally, while video modeling without feedback has not been found to be an effective method for improving gross motor skills, a significant advantage of the HOPSports system may be the ability of the module to engage a classroom of students while the PE instructor moves throughout the room providing individual feedback on participant form.



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