\\

HOPSports

Pilot Program

Financial Benefit-Cost Analysis

Be Active North Carolina, Inc. recently sponsored the implementation of HOPSports, an innovative physical activity program. Thirty (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 (a) youth's enjoyment of the Hops system, (b) learning outcomes achieved with the Hops system, (c) ease of use of the Hops system, and (d) how Hops may or may not enhance the quality of students' physical education.

In addition to participation in this state-wide assessment, **three (3) schools in NC were selected to participate in an additional "Physical Activity Outcomes" assessment of Hops**. The "Outcomes" assessment, like the broader study, is sponsored by *Be Active North Carolina* and *Be Active Appalachian Partnership* and runs concurrent with the broader statewide pilot study. **The purpose of the additional physical activity assessment is to compare students' physical activity outcomes in physical education (PE) classes comprised of Hops vs. traditional PE classes without Hops.**

Essentially, this information will tell decision-makers whether students are more physically active in Hops-inclusive PE classes. Further, results from this additional study will reveal 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).

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

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 they participated in. As such, the physical activity outcome will provide information on the number of minutes spent in sedentary, light, moderate, and vigorous physical activity. This information allows practitioners to test the efficacy of Hops for increasing students' physical activity intensity during scheduled physical education classes.

In addition to the initial ***"Physical Activity Outcomes"*** evaluation conducted by researchers at Appalachian State University and East Carolina University, **Be Active North Carolina** requested an independent financial (benefit-cost) analysis of the HOPSports program. The following pages describe this particular analysis.

Evaluation Framework

Upon reviewing the *Physical Activity Outcomes* study, researchers constructed a customized evaluation framework in which to perform a *financial benefit-cost analysis* of the HOPSports Pilot Program (see table 1).

Table 1

Evaluation Framework of the HOPSports Pilot Program

Target Population	Variables	Source	Time of Measurement	Per Site Outcome Data
Schools (3)	A. Medical care cost per inactive child per year	2007 N.C. Youth (School-Age Child) Econ Study	August 2007	Total medical care cost for all inactive children
	B. Participation in MVPA*	Activity monitor	End of Pilot	Time (minutes) spent in MVPA*
	C. Programming cost	Be Active North Carolina	End of Pilot	Cost of HOPSports
	D. Estimated cost-savings	Formula comprised of variables A & B	February 2008	Estimated Medical care cost-savings
	E. Programming Cost and estimated cost savings	Formula comprised of C & D	February 2008	Benefit-to-cost ratio

** Moderate and vigorous physical activity*

Pilot Results

Participation levels associated with Hops vs. Non-Hops were obtained from the initial *Physical Activity Outcomes* study. These results, as shown in table 2, suggest students are ***significantly more active with HOPs*** than during traditional PE class sessions.

TABLE 2

Students Wearing Actigraph Monitors

Level of Physical Activity	Non-HOPS			HOPs			Difference	
	%	#	Mins.	%	#	Mins.	#	Minutes
Sedentary	36%	139	14.4	23%	89	9.2	-50	-5.2
Light < 3 METS*	26%	101	10.4	18%	70	7.2	-31	-3.2
Moderate*: 3.01-6 METS	34%	132	13.6	48%	186	19.2	+54	+5.6
Vigorous*: >6 METS	4%	15	1.6	11%	42	4.4	+27	+2.8
TOTAL (MVPA)	**38%**	**147**	**15.2**	**59%**	**228**	**23.6**	**+81**	**+8.4**

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 Trost's cut points for youth (Trost et al., 2002).
* METS=metabolic equivalent of physical activity

Table 2 reveals that a substantial number of youngsters migrated into ***moderate and vigorous physical activity*** (MVPA) during their transition to HOPs – an increase of ***more than 55 percent***. Moreover, the time invested in MVPA during HOPs increased 8.4 minutes [15.2 to 23.6 minutes or 55%]. Arguably, these changes are likely to generate ***incremental*** physiological benefits since more youngsters (1) engaged in a ***higher level of exercise intensity*** (from sedentary/light to **MVPA**) and (2) simultaneously did so over a ***longer period of time*** (e.g., more minutes in **MVPA**). Thus, in order to factor in this ***compound*** benefit, the following equation was used:

Additional Participants in MVPA[1] ____
Additional Time in MVPA ***x*** ____
Adjusted # of Positive Impacts _____

[1] ***Number of participants wearing Actigraph monitors (387)***

Considering *greater MVPA participation* –and- *greater time spent in MVPA during Hops*, the preceding equation would be completed as follows:

Additional Participants in MVPA[1]	***374***
Additional Time in MVPA	***x 1.5526 (55.26%)***
Adjusted # of Positive Impacts	***581***

[1] Eighty-one (81) of 387 Actigraph-wearing participants actually migrated from no or light physical activity to MVPA; 81 divided by 387 = 20.9 percent; 20.9% multiplied by 1,789 (all participants) = 374 actual MVPA achievements.

Essentially, the preceding equation shows that (a) 374 more youngsters engaged in MVPA for the first time and (b) did so considerably longer (55%) during Hops. Thus, considering the additional time (8.4 more minutes) spent in MVPA by the 374 youngsters, the expected physiological benefit would be equivalent to that of ***581 subjects engaging in MVPA*** at only the ***standard Non-Hops timeframe*** (15.2 minutes). This comparison is reflected below:

	Actual	**Comparative Equivalent**
Participants	374	581
MVPA minutes (ave.)	x 23.6*	x 15.2**
Total minutes	8,826	8,831

* With Hops
** Baseline, without Hops

Statistical Testing

To determine if any difference in MVPA between Non-HOPS vs. HOPS is statistically noteworthy, an ***analysis of variance (ANOVA)*** was used (see table 3).

The term *analysis of variance* is a source of confusion for some people. In spite of its name, ANOVA is concerned with differences between *means* of groups, not differences between *variances.* The name ***analysis of variance*** comes from the way the procedure uses variances to decide *whether the* ***means*** *are different*. Ironically, some statisticians contend that a better acronym for this model would be *ANOVASMAD* (analysis of variance to see if means are different). The way ANOVA works is relatively simple: the statistical program looks to see what the variation (variance) is ***within*** the groups, then works out how that variation would translate into variation (i.e. differences) ***between*** the groups, taking into account how many subjects there are in the groups. If the observed differences are a lot bigger than what you'd expect by chance, you have statistical significance. In our example, there are only two interventions (Hops vs. Non-Hops), so variation between groups is just the ***difference between the means***.

Table 3

Youngsters (387) Wearing Actigraph Monitors

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	153	460	3.00	0.097076669
Column 2	234	730	3.11	0.153183176

ANOVA

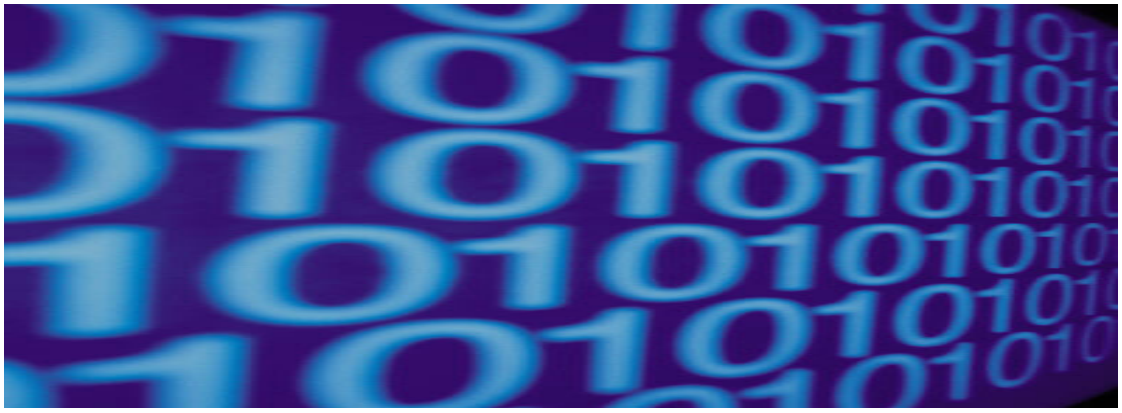
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.570543787	1	0.570543787	4.349007444	***0.037****	3.86637536
Within Groups	49.19603446	386	0.131189425			
Total	49.76657825	387				

* *Statistically significant.*

The top part of the ANOVA table consists solely of descriptive statistics as it provides the number of subjects and average scores. The bottom part of the ANOVA table contains the most pertinent data, especially the "P-Value." The ***P Value*** is a probability consisting of a value ranging from zero to one. If the P value is small, you can

conclude the difference between sample means is unlikely to be a coincidence or chance and, therefore, likely to be due to the intervention.

Considering a ***P value*** of ***.03***, we can say that if a random sampling of the Hops program was conducted on identical populations (e.g., other public school-age children in North Carolina), it would lead to a difference of mean averages smaller than we observed in 97% of the interventions and a difference of mean averages larger than we observed in 3% of the interventions. Since statisticians consider a ***P-Value*** of ***.05 or lower*** to be ***statistically significant***, it appears there ***is*** a significant difference in MVPA means between the pilot Hops program and traditional [Non-Hops] physical education classes.



Financial Benefits vs. Costs

Now that the preceding descriptive and statistical data comparisons have been conducted, we shift our attention to a ***financial-oriented*** analysis. The purpose of a financial benefit-cost analysis is to answer the following question:

"How do any financial *benefits* accruing from HOPs compare to the financial *cost* of proving HOPs?"

The first step involved in conducting a customized benefit-cost analysis of Hops is to establish a demographic profile of the target population. The three schools which serve as the target population for this analysis reported an average daily attendance of 1,789 students. A total of **387** students completed assent forms, returned parental consent forms, and ***actually wore Actigraph monitors*** in the HOPS Activity Outcomes study: 76 youngsters at West Lenoir Elementary School participated; 65 middle-school students from Cane Creek Middle School participated; and, 265 youth at Central Wilkes School participated.

One Factor Cost vs. Benefit Comparison

Since physical inactivity is a well-established risk factor for many medical conditions in both adults and children, the primary *financial* ***benefit*** selected for this particular study is ***medical care cost***.

As with many benefit-cost analyses, there are various methodologies that can be employed to determine if benefits equal or exceed the cost of a particular intervention. The most immediate – and perhaps simplest – method is to compare ***aggregate costs*** vs. ***aggregate benefits***. This approach requires us to (a) determine the direct intervention cost, (b) identify the number of new "MVPA impacts," (c) assign a financial value to the specified benefit variable (medical cost per child), and (d) calculate aggregate cost-savings. This is reflected below:

Cost Side

HOPSports Per School		# Schools		Total Cost
$17,500	**x**	**3**	**=**	***$52,500***

Benefit Side

HOPs-Induced Impacts*		Medical Cost Per Child**		Aggregate Cost-savings
581	**x**	**$125**	**=**	***$72,625***

* "MVPA impacts" (difference in the adjusted number of children engaged in moderate or vigorous physical activity (MVPA) during the HOPs program vs. the Non-Hops traditional PE program.)
** This is the average annual medical care cost per child attributed *exclusively to physical inactivity*; this cost is extracted from "*A Financial Cost Appraisal of Physical Inactivity, Excess Weight, and Type II Diabetes in School-Age Children in North Carolina.*" February 22, 2008.

A direct comparison of the preceding cost and benefit values yields the following ratio:

Cost		$52,500		$ 1.00		
--------	=	----------	=	---------	=	+ 38% ROI
Benefit		$72,625		$ 1.38		

In essence, the direct cost-to-benefit comparison shows a ***positive*** return on investment (ROI) characterized by **generating $1.38 in cost savings for every $1 spent on HOPSports.**

Break-Even Analysis Method

The preceding method treated the cost of HOPSports as an *annual cost* when, in reality, the cost of this intervention should be considered as a **one-time, up-front cost that can be applied *over several years***. Therefore, given the more realistic ***multi-year*** cost application of HOPSports, a more prudent methodology would be to **divide the cost of the program** –by- the **per capita medical cost of physical inactivity**. In doing so, this equation would render the following outcome:

Program Cost of HOPSports[@]		Per Capita Medical Cost[@@] of Physical Inactivity		Minimum Number of MVPA Impacts Needed
$ 17,500	/	$125	=	***140***

[@] Upfront cost that can potentially be spread over several years
[@@] Per year

The preceding equation shows that a minimum of 140 youngsters – ***exercising in MVPA for approximately 23.6 minutes*** – would incur a level of physiological benefits sufficient to produce enough medical care cost savings to offset the cost of the HOPSports intervention. Simply put, this is known as a ***annualized break-even point*** in which benefits equal costs. Table 4 illustrates the minimum number of MVPA impacts at corresponding one-minute intervals in which individuals would have to engage in MVPA to reach a break-even point at one-year intervals.

Table 4

Break-Even Point Distributions at 1, 2, 3 and 4 Years

4-Year Projected Program Cost	Per Capita Medical Cost	MVPA Minutes	Minimum Impacts at 1 Year	Minimum Impacts at 2 Years	Minimum Impacts at 3 Years	Minimum Impacts at 4 Years
$17,500	$125	23.6	140	70	46	35
$17,500	$125	24	138	69	45	34
$17,500	$125	25	132	66	44	33
$17,500	$125	26	127	64	42	32
$17,500	$125	27	122	61	40	31
$17,500	$125	28	118	59	39	30
$17,500	$125	29	114	57	38	28
$17,500	$125	30	110	55	36	28
$17,500	$125	31	107	53	35	27
$17,500	$125	32	103	52	34	26
$17,500	$125	33	100	50	33	25
$17,500	$125	34	97	49	32	24
$17,500	$125	35	94	47	31	24

$17,500	$125	36	92	46	30	23
$17,500	$125	37	89	45	29	22
$17,500	$125	38	87	43	29	22
$17,500	$125	39	85	42	28	21
$17,500	$125	40	83	41	27	21

Overall, table 4 shows that a minimum of ***21 to 140*** youngsters – ***exercising in MVPA at designated one-minute intervals*** - would generate a break-even point in which ***cost-savings would offset programming costs***. Since this is a broad range, let's use a median approach to provide a more realistic estimate of MVPA impacts needed to justify the cost of HOPSports. In doing so, table 5 is used to present various break-even scenarios.

Table 5

Median[1] Number of MVPA Impacts at One-Year Intervals

	Minimum Number of MVPA Impacts		
Year	**@ 23.6 minutes**	**@ 40 minutes**	**Median**
1	140	83	111.5
2	70	41	55.5
3	46	27	36.5
4	35	21	28.0

[1] *50% percentile*

Table 5 shows that approximately 111 youngsters engaged in MVPA for nearly ***32 minutes* per session*** would generate sufficient medical care cost savings to offset the cost of HOPSports (e.g., "break-even status"). By the two year mark, approximately 55 youngsters engaged in 32 minutes of MVPA would achieve break-even status; by year three, approximately 36 youngsters similarly engaged in MVPA would achieve break-even status; and, finally, at the end of the projected four-year lifespan of HOPSports, approximately 28 youngsters engaged MVPA for approximately 32 minutes would achieve break-even status. In essence, ***the longer that HOPSports is in operation, the fewer the number of MVPA impacts needed to show cost-effectiveness.***

**** Median (midpoint) between 23.6 minutes and 40 minutes.***

Implications

For new adopters of HOPSports, ***what level of MVPA impact*** is necessary to justify (break-even) the cost of the intervention? In order to answer that question, we can apply the pilot program results to a school with a average-sized student population of, say, 500 students. The following equation – incorporating ***actual pilot study results***[1] – yields probable cost-savings and benefit-to-cost outcomes, as follows:

Student population	500
Percentage Impact	.209 (20.9%)[1]
# of new MVPA impacts	104.5
Compound multiple	x 1.55 (55%=additional time in MVPA)[1]
Adjusted new MVPA impacts	161.97
Cost-savings per impact	x $125
Total cost-savings	$20,246

$$\frac{\text{Benefit}}{\text{Cost}} = \frac{\$20{,}246}{\$17{,}500} = \frac{1.15}{1.00} = 15\%\ \text{ROI}$$

The preceding ROI shows that for every $1 spent on the HOPSports program generates $1.15 in potential [medical care] cost-savings. Time wise, HOPSports would be expected to generate a ***payoff (reach break-even status) around 10.37 months*** based on the following:

Cost of HOPSports ($17,500) – divided by - $1,687 (monthly benefit) = 10.37 months

Conclusion

The initial "*Physical Activity Outcomes*" study demonstrated a statistically significant ($p<.01$) increase in the amount of MVPA achieved by students in HOPSports. vs. Non-HOPs. Specifically, that particular study, which focused primarily on **descriptive** physical activity outcomes, showed a substantial gain of 8.4 minutes of MVPA during HOPSports sessions.

As a supplement to the preceding study, the focus of this follow-up analysis converted **descriptive outcomes into financial values**. In particular, it found a statistically significant ($p<.03$) increase in the number of youngsters migrating to MVPA. Moreover, it found that the cost of a HOPSports program could be offset by MVPA-generated medical care cost savings within 10-11 months, and that a return on investment (ROI) of 15% is likely with reported pilot study impacts. Overall, this particular study suggests that actual MVPA patterns *are sufficient to justify the cost of HOPSports* from a *monetary point of view*.

Preliminary ["Pilot"] results suggest that actual MVPA patterns are sufficient to justify the cost of HOPSports from a *monetary point of view.*

References

Trost, S., Pate, R., Sallis, J., Freedson, P., Taylor, W., Dowda, M., et al. (2002). Age and gender differences in objectively measured physical activity in youth. *Medicine & Science in Sports & Exercise, 34*(2), 350-355.

A New View of Statistics. T Test and One-Way ANOVA. [http://www.sportsci.org/resources/stats/ttest.html] accessed February 7, 2008.