

PHYSICAL EDUCATION: IT WORKS OUT

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Project 6.3 / August 2012

POLICY QUESTION: Does the Healthy Active Children policy recommendation of 150 minutes of physical education with a specialist each week correlate with higher End of Grade assessment proficiency in grades three through five?

EXECUTIVE SUMMARY

North Carolina's State Board of Education developed guidelines to improve the health and well-being of students across the state and implemented them as part of the Healthy Active Children policy in the 2006-2007 school year. The guidelines require schools to offer 30 minutes of physical activity each day for elementary school students and LEAs to develop School Health Advisory Councils. The policy also recommends that elementary schools offer students 30 minutes of physical education (PE) with a specialist each day. In this study, we look at the End of Grade assessment proficiency rates of elementary schools in LEAs that meet this recommendation compared to the proficiency of those schools in LEAs that do not. We ultimately find evidence that rates of proficiency on End of Grade tests are higher in the schools that meet the recommendation for 150 minutes of PE with a specialist each week.

INTRODUCTION

BACKGROUND

As American public school systems have experienced dramatic financial reductions in recent years, cutting physical education (PE) spending has frequently emerged as a way to reduce costs while preserving academic programs. Such suggestions have fueled debate about the role of PE and physical activity in supporting students' health and academic performance. Proponents of PE have argued that increased rates of childhood obesity increase students' risk for poor academic outcomes later in life (Sallis et al. 1999). In light of these policy discussions, we decided to examine the role daily PE plays in increasing academic performance of North Carolina elementary school students.

It is important to note the distinction between physical activity and PE, especially in terms of developing policy. Physical activity can include recess, games, simple exercises in the classroom, or anything involving some form of activity. However, the North Carolina State Board of Education (SBE) defines Physical Education as a specified, prolonged period of time during which a PE specialist instructs children on health topics and leads them in group exercise (Board of Education 2005). While many schools allow for recess or other physical activity on a regular basis, students may only have PE with a specialist once a week.

The SBE adopted the Healthy Active Children (HAC) policy in 2003 (later amended in 2005) to address the differences between physical activity and PE, as well as to encourage schools to offer PE to their students. North Carolina officially implemented the policy during the 2006-2007 school year with the cooperation of the North Carolina Department of Public Instruction (NCDPI) and local School Health Advisory Councils. The policy recommends that elementary school students receive a minimum of 150 minutes of PE with a specialist each week (Board of Education 2005). The SBE suggests, but does not require, that LEAs meet HAC recommendations.





PREVIOUS RESEARCH

Over the past 25 years, many researchers have examined how physical activity and PE affect various aspects of a child's growth and development, including cognitive maturation, emotional and social advancement, and academic performance throughout grade school. The research has shown that students engaged in regular PE instruction tend to have a much lower occurrence of disruptions and other misconduct in the classroom. Fewer disruptions can ultimately lead to higher academic performance and higher quality instruction for the entire class (Dwyer, Blizzard and Dean 1996).

Other research, focused on the emotional benefits of regular physical activity and PE, showed similar effects. These studies found reduced levels of anxiety and stress and increased levels of self-esteem in students taking regular PE classes. Such emotional benefits result in academic and personal improvement as well as an environment more conducive to instruction and social growth for all students (Calfas and Taylor 1994).

Additional studies focus solely on the academic benefits associated with regular PE. One such study analyzed the positive academic gains associated with a healthy lifestyle taught through regular PE to groups of third and fourth grade students. After comparing an experimental group of students receiving comprehensive school health education to a control group that did not, researchers found that the experimental group scored higher on assessments in both reading and math (Schoener, Guerrero and Whitney 1988). Another study analyzed teachers' observations

of improvements in classroom performance and student behavior (Dwyer, Blizzard and Dean 1996) and showed students participating in regular PE exhibited significant gains in both areas.

A final area of research covers the opportunity costs associated with increasing the frequency of PE classes with a specialist. Because time spent in PE reduces the available time for academics, it seems logical that academic performance might suffer. Nevertheless, several studies have actually shown a marked increase in standardized test scores for students engaging in regular physical activity under the guidance of a PE specialist, despite the loss of academic classroom time (Sallis et al. 1999; Shepard 1996; Dwyer et al. 1983).

In light of this previous research, we hypothesized those North Carolina elementary schools which met HAC recommendations would have higher average academic performance.

METHODS

DATA COLLECTION

To test for a relationship between elementary PE and academic performance, we analyzed the effect of compliance with HAC guidelines on a school's End of Grade (EOG) test¹ proficiency rate. We determined compliance with HAC guidelines using the results of a 2011 NCDPI survey that asked LEAs about their physical activity and PE policies.² We also gathered data on proficiency levels on EOG tests for the 2010-11 school year from the annual

¹ EOG tests are statewide summative assessments given to students at the end of grades three through eight in reading and math, as well as science test in grades five and eight. Students receive a score of one through four.

² The relevant portion of the survey instrument and a map showing survey responses by district is available in Appendix A.

NC School Report Card (Department of Public Instruction 2011). EOG proficiency figures reflect the percentage of students scoring at level 3 or higher (out of 4) for each subject test.

Because HAC recommendations differ for middle schools, we limited our analysis to elementary schools. Moreover, because EOG tests are not administered until the third grade, we were unable to analyze the impacts of HAC compliance in grades K-2. Therefore, our final dataset included only students in the third through fifth grades.

We also obtained school level demographic data from the NC School Report Card database. That data included racial composition, gender composition, and percentage of students receiving free and reduced-price lunch (FRL) at each school and grade level. We also acquired information on general school and LEA-level factors including total attendance, number of teachers, and per-pupil expenditures (PPE).

DATA REVISION

Many of the LEAs responding to the NCDPI survey stated that physical education policies varied by school.³ We conducted further inquiry to verify which schools in specific LEAs met the HAC recommendations. After following up with these LEAs, we obtained full information on all but five small LEAs. Eliminating non-responding LEAs from our sample decreased our number of data points by 205 (2.3 percent), leaving us with a total sample size of 8,976 data points (each data point represents the percent proficient for one grade on one test in one school).



ANALYSIS

We modeled the relationship between various explanatory factors and EOG proficiency using a Generalized Linear Model. Using this type of model, we could control for similarities between schools operating inside the same LEA. Logic dictates that two schools in the same LEA would be far more similar than two schools in different LEAs. Failing to control for those similarities could lead to statistical errors. Our models enabled us to look at the overall effect of meeting the HAC guidelines on rates of EOG proficiency for each subject. We also examined the impacts specifically based on students' gender and for FRL students.⁴

ALL STUDENTS

Our model of the relationship between daily PE and EOG proficiency for all students showed a statistically significant improvement for both math and reading EOGs, but not for science EOGs.

As shown in the table below, meeting the HAC recommendations correlated to an estimated 5 percentage point improvement in math EOG proficiency. Large proportions of minority and FRL students correlated to a statistically significant drop in proficiency. Similarly, outcomes for the reading EOG showed an even greater impact of PE on proficiency, with schools meeting the HAC recommendations increasing their rates of reading proficiency by almost 8 percentage points. Racial and FRL factors were even more significant with respect to reading EOG outcomes than for math.

Daily PE and proficiency on the science EOG did not have a statistically significant relationship. However, other factors including school racial composition and rates of FRL students do impact science EOG proficiency levels in a statistically significant way.

We did find a significant relationship between proficiency on all tests and PPE. However, the strength of the relationship only indicated a one-hundredth of a percentage point increase in proficiency for every dollar increase in PPE, a small overall influence on EOG scores compared to other factors.

ALL STUDENTS

Explanatory Variables	Math	Reading	Science
Meet HAC Rec's	5.15%**	7.92%**	5.69%
% FRL	-.13%**	-.25%**	-.20%**
% Hispanic	-.04%**	-.17%**	-.13%**
% African American	-.19%**	-.19%**	-.27%**
Total PPE	.01%**	.01%**	.01%**

All findings are shown as percentage points.

**Indicates statistical significance at the 95% confidence level.

³ Sample responses from LEAs with policies that vary by school are available in Appendix A.

⁴ Complete statistical outputs for all of our models are available in Appendix B.



FEMALE STUDENTS

After examining overall outcomes from PE policies, we divided our analysis by gender to determine whether daily PE affects males and females in different ways. When investigating the relationship between daily PE and math EOG proficiency for females, we found no significant relationship. However, the negative effect with regard to school racial composition and percent FRL persisted.

We found limited evidence of a relationship between HAC compliance and rates of reading EOG proficiency for females in our study, though it was only significant at the 10 percent level, falling short of the more rigorous 5 percent test for statistical significance most commonly used in social-scientific research. However, once again, the negative effect of school racial composition and percent on FRL persists and is stronger for reading than math.

The trend on proficiency from a financial perspective repeats for females, showing a statistically significant correlation for math and reading EOGs with regard to PPE. However, the magnitude again is very small.

Daily PE has no significant impact on science EOG tests for females.

MALE STUDENTS

For males, there is evidence that daily PE improves math EOG scores, though the relationship was only significant at the 90% confidence level. The magnitude would be moderately impressive, showing a 5 percentage point improvement in proficiency in schools offering daily PE. We observed an impact of race only with regards to percent of students that were African American, though the negative impacts of having high numbers of students on FRL persisted.

The correlation between daily PE and reading EOG proficiency for males is the strongest of all the comparative group results in this study, and most likely the largest driving factor of the strong correlation observed for all students. Our findings point to an improvement of almost 9 percentage points in reading EOG proficiency for male students in schools meeting the HAC recommendations. However, reading proficiency for males is also the most sensitive to other factors such as race and socio-economic status. Reading assessments are also the only subject for male students wherein proficiency correlates to an increase in PPE, but the magnitude is very small.

The findings for males taking the science EOG are not significant. Although daily PE has no effect on science

FEMALE STUDENTS

Explanatory Variables	Math	Reading	Science
Meet HAC Rec's	1.89%	4.56%*	2.74%
% FRL	-.16%**	-.29%**	-.29%**
% Hispanic	-.07%**	-.17%**	-.17%**
% African American	-.18%**	-.16%**	-.27%**
Total PPE	.01%**	.01%**	.01%

All findings are shown as percentage points.

**Indicates statistical significance at the 95% confidence level.

*Indicates significance at the 90% confidence level.

MALE STUDENTS

Explanatory Variables	Math	Reading	Science
Meet HAC Rec's	4.81%*	8.85%**	6.51%
% FRL	-.15%**	-.27%**	-.17%**
% Hispanic	-.01%	-.18%**	-.13%**
% African American	-.18%**	-.22%**	-.28%**
Total PPE	0%	.01%**	.01%

All findings are shown as percentage points.

**Indicates statistical significance at the 95% confidence level.

*Indicates significance at the 90% confidence level.

proficiency, other considered factors including race and FRL status do negatively impact science scores.

FRL STUDENTS

Daily PE continues to have the greatest effect on reading EOG proficiency when analyzed for its effect on FRL students. The magnitude of the result suggests an estimated improvement of just over 8 percentage points for FRL students at schools meeting HAC guidelines. Much like the results for males, all other factors considered were significant, again showing the strong influence of outside factors on reading EOG proficiency.

There is little indication of any significant gains from daily PE on science or math EOG scores for FRL students. However, we once again noted the adverse impacts of high African American and FRL school populations on these EOG tests. Interestingly, these results suggest that FRL students tend to perform better academically in schools with low levels of FRL students.

Once again, there is a statistically significant relationship between PPE and proficiency on math and reading for FRL students. However, similar to the trend seen for all other groups, the relationships are very small, particularly for math, indicating a very minor level of influence.



one percent of the variation in whether a school was HAC compliant. In fact, a \$1,000 increase in PPE only correlated to a 3.17 percent increase in the probability that a given school complied with HAC guidelines. This means that average PPE in North Carolina would have to be tens of thousands of dollars higher in order for our model to predict that all schools had a 100 percent chance of meeting HAC guidelines. Given this relatively weak relationship, we were not surprised to find that the average PPE in schools meeting the HAC recommendations was only \$258 higher than the average PPE in schools not meeting the recommendations. While the difference qualifies as statistically significant, it is materially inconsequential.

FRL STUDENTS

Explanatory Variables	Math	Reading	Science
Meet HAC Rec's	4.12%	8.1%**	6.8%
% FRL	-.05%**	-.13%**	-.11%**
% Hispanic	.04%*	-.11%**	-.05%
% African American	-.15%**	-.13%**	-.22%**
Total PPE	.0001%**	.01%**	.01%

All findings are shown as percentage points.

**Indicates statistical significance at the 95% confidence level.

* Indicates significance at the 90% confidence level.

EFFECT OF PER PUPIL EXPENDITURES

We suspected that LEAs with higher PPE might be both more likely to have high rates of EOG proficiency and also more likely to be able to afford PE specialists. To control for these factors, we included PPE in our regression model, which allowed us to isolate the impact of the HAC policy while keeping PPE constant.

We also ran a simple regression to look for a correlation between total PPE and HAC compliance. The results showed a statistically significant correlation between PPE and HAC policy. However, changes in PPE explained less than half of

CONCLUSION

The evidence of our study indicates a statistically significant relationship between daily PE and student performance on math and reading EOGs at the third through fifth grade levels. In fact, we found that the effects of PE were large enough to compensate for fairly large proficiency losses in other areas. For example, on the reading EOG, proficiency gains as a result of meeting HAC guidelines were substantial enough to offset proficiency losses accompanying a 39 percentage point increase in a school's rate of FRL students. In math, meeting the HAC guidelines could also offset proficiency losses from a 31 percentage point increase in the number of FRL students.⁵

However, despite the dramatic findings for math and reading EOGs, our study did not find statistically significant results for outcomes on the science EOG. It is possible that the smaller sample size for science, as the science EOG is only administered

⁵ Thirty-one percentage points calculated using an estimated proficiency gain of 7.92 percentage points in Reading, and a proficiency loss of 0.25 percentage points per one percentage point increase in percent FRL. Thirty-nine percentage points calculated using an estimated proficiency gain of 5.15 percentage points in Math, and a proficiency loss of 0.13 percentage points per one percentage point increase in percent FRL.

⁶ Thirty-three percentage points calculated using an estimated proficiency gain of 8.85 percentage points in Reading, and a proficiency loss of 0.27 percentage points per one percentage point increase in percent FRL. Sixty-two percentage points calculated using an estimated proficiency gain of 8.1 percentage points in Reading, and a proficiency loss of 0.13 percentage points per one percentage point increase in percent FRL.

in fifth grade, could explain the lack of a significant finding. It may also simply be that PE does not increase science proficiency.

We also found that the results for math and reading EOGs held true for specific subsets within the population. Understanding which subgroups benefit most from PE could help with effective implementation of PE policies. For example, the fact that the most significant gains we observed were in reading EOG results for male students and FRL students could be especially helpful given the recent push by state legislators for improved literacy at the elementary level (General Assembly 2012). For males, reading EOG gains from meeting HAC guidelines were statistically equivalent to the benefits of reducing a school's number of FRL students by 33 percentage points. Even more dramatically, for FRL students, daily PE could offset proficiency losses associated with a 62 percentage point increase in the number of FRL students in their school.⁶ Given these kinds of outcomes for FRL students, schools could dramatically increase EOG performance for some of their most disadvantaged students by adopting the HAC recommendations.

Ultimately, our results show a clear relationship between PE and academic performance. Daily PE increases rates

of proficiency on EOG reading and math tests for students across the board. Moreover, it has even larger effects on academic outcomes for specific populations. As with previous research, our study indicates that increasing compliance with HAC recommendations could positively increase academic performance throughout North Carolina.

POLICY RECOMMENDATIONS

- 1. Require all LEAs to adopt HAC recommendations for elementary students.** Our evidence suggests that the state could make significant gains in EOG test proficiency by implementing HAC recommendations at the elementary level for all students.
- 2. Focus on providing daily PE in LEAs with high numbers of FRL students if budget constraints preclude the full implementation of daily PE.** Benefits from PE were most significant for FRL students, so it makes sense to target physical education programs to LEAs with larger FRL populations.



APPENDIX A – SURVEY INSTRUMENT AND RESPONSES

QUESTIONS FROM NCDPI SURVEY RELATING TO HEALTHY ACTIVE CHILDREN RECOMMENDATIONS

Question 22: ALL elementary schools in our LEA currently provide:

- 150 minutes per week of physical education taught by a physical education specialist.
- Other, please specify

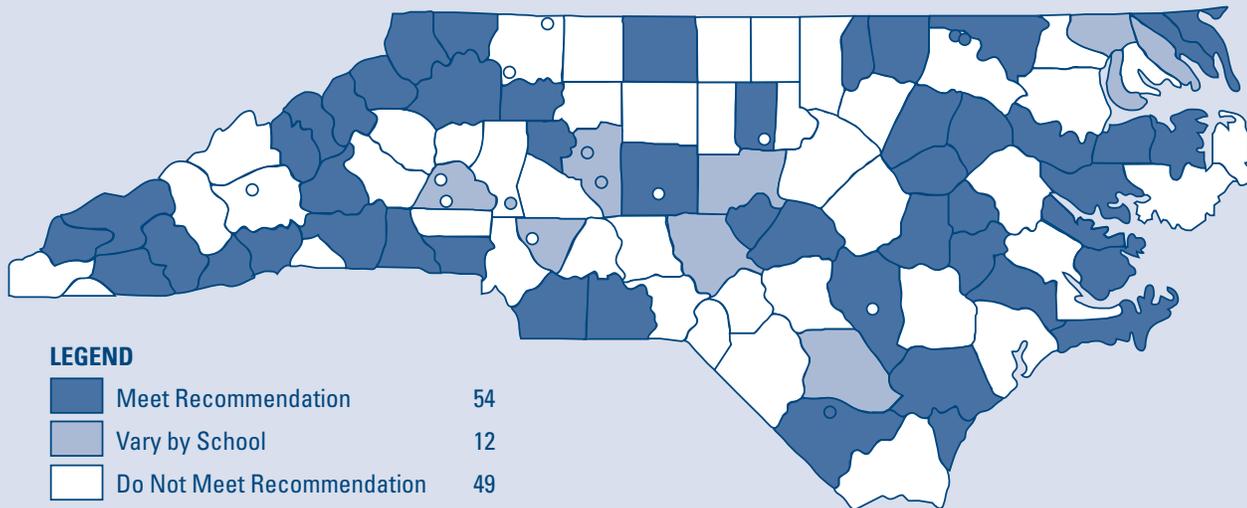
Question 22: Other, please specify:

SAMPLE RESPONSES FROM LEAS WITH POLICIES THAT VARY BY SCHOOL

- Davidson: “Varies by school”
- Chatham: “30% (3 of 10) schools provide 150 min/wk.”
- Moore: “Varies by school, average # of minutes = most elementary schools 45min/week”
- Bladen: “At least 2 schools only get 50min per week”

RESPONSES BY DISTRICT

North Carolina School Districts Meeting Healthy Active Children Policy Recommendation for 150 minutes PE Weekly with Specialist



Developed by FBS Summer Interns (2012) with Data Compiled from Healthy Active Children Policy Survey and the NC School District Shapefile from Census/TIGER Files

APPENDIX B – STATISTICAL OUTPUT

REGRESSION RESULTS FOR ALL STUDENTS

Model for All Proficient (Math)							
Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.3602	0.1612	0.0442	0.6761	4.99	0.0255
Meet HAC Rec's	1	0.0515	0.0229	0.0066	0.0964	5.06	0.0245
Student/Teach Ratio	1	0.0081	0.0009	0.0064	0.0097	89.84	<.0001
% Free/Red Lunch	1	-0.001299	0.000115	-0.001525	-0.001073	127.15	<.0001
% Hispanic	1	-0.000381	0.000161	-0.000697	-0.000065	5.57	0.0183
% African American	1	-0.001879	0.000112	-0.002099	-0.001658	279.62	<.0001
Total PPE	1	0.0001	0	0	0.0001	7.74	0.0054

Model for All Proficient (Reading)							
Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.029	0.1733	-0.3106	0.3686	0.03	0.867
Meet HAC Rec's	1	0.0792	0.0246	0.031	0.1274	10.35	0.0013
Student/Teach Ratio	1	0.0053	0.0009	0.0035	0.0071	33.14	<.0001
% Free/Red Lunch	1	-0.002537	0.000124	-0.00278	-0.002295	419.92	<.0001
% Hispanic	1	-0.00169	0.000173	-0.00203	-0.00135	94.91	<.0001
% African American	1	-0.001926	0.000121	-0.002162	-0.001689	254.27	<.0001
Total PPE	1	0.0001	0	0.0001	0.0001	20.48	<.0001

Model for All Proficient (Science)							
Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.3616	0.3573	-0.3387	1.062	1.02	0.3115
Meet HAC Rec's	1	0.0569	0.055	-0.0509	0.1646	1.07	0.3009
Student/Teach Ratio	1	0.0079	0.0019	0.0042	0.0117	17.11	<.0001
% Free/Red Lunch	1	-0.002013	0.000254	-0.002511	-0.001514	62.66	<.0001
% Hispanic	1	-0.001313	0.000371	-0.00204	-0.000586	12.53	0.0004
% African American	1	-0.002703	0.000251	-0.003196	-0.00221	115.52	<.0001
Total PPE	1	0.0001	0	0	0.0001	1.54	0.2143



REGRESSION RESULTS FOR FEMALES

Model for Female Proficient (Math)

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.3361	0.1797	-0.0161	0.6883	3.5	0.0615
Meet HAC Rec's	1	0.0189	0.0251	-0.0303	0.0681	0.57	0.452
% Free/Red Lunch	1	-0.001578	0.000131	-0.001835	-0.001321	144.73	<.0001
% Hispanic	1	-0.000708	0.000177	-0.001054	-0.000362	16.08	<.0001
% African American	1	-0.001765	0.000123	-0.002006	-0.001523	204.69	<.0001
Total PPE	1	0.0001	0	0	0.0001	12.27	0.0005
Student/Teach Ratio	1	0.0012	0.001	-0.0008	0.0033	1.41	0.2352

Model for Female Proficient (Reading)

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.3332	0.1963	-0.0515	0.7179	2.88	0.0896
Meet HAC Rec's	1	0.0456	0.0274	-0.0081	0.0994	2.77	0.0962
% Free/Red Lunch	1	-0.002894	0.000143	-0.003175	-0.002613	408.35	<.0001
% Hispanic	1	-0.001744	0.000193	-0.002122	-0.001366	81.81	<.0001
% African American	1	-0.001598	0.000135	-0.001862	-0.001334	140.77	<.0001
Total PPE	1	0.0001	0	0	0.0001	10.71	0.0011
Student/Teach Ratio	1	-0.0006	0.0011	-0.0028	0.0017	0.25	0.6195

Model for Female Proficient (Science)

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.4857	0.4136	-0.3249	1.2963	1.38	0.2403
Meet HAC Rec's	1	0.0274	0.0609	-0.092	0.1467	0.2	0.6531
% Free/Red Lunch	1	-0.002861	0.000298	-0.003445	-0.002277	92.13	<.0001
% Hispanic	1	-0.001655	0.000416	-0.00247	-0.00084	15.84	<.0001
% African American	1	-0.002682	0.000281	-0.003233	-0.002131	90.93	<.0001
Total PPE	1	0.0001	0	0	0.0002	1.63	0.2021
Student/Teach Ratio	1	-0.0031	0.0024	-0.0079	0.0016	1.65	0.1993





REGRESSION RESULTS FOR MALES

Model for Male Proficient (Math)

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.537	0.1877	0.1691	0.9049	8.19	0.0042
Meet HAC Rec's	1	0.0481	0.0269	-0.0047	0.1009	3.18	0.0744
% Free/Red Lunch	1	-0.00153	0.000132	-0.001789	-0.00127	133.35	<.0001
% Hispanic	1	-0.000101	0.000186	-0.000465	0.000263	0.3	0.5851
% African American	1	-0.001837	0.000129	-0.002091	-0.001584	202.33	<.0001
Total PPE	1	0	0	0	0.0001	2.34	0.1264
Student/Teach Ratio	1	0.0068	0.001	0.0048	0.0087	46.54	<.0001

Model for Male Proficient (Reading)

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	-0.0105	0.2086	-0.4192	0.3983	0	0.96
Meet HAC Rec's	1	0.0885	0.0299	0.0299	0.1472	8.75	0.0031
% Free/Red Lunch	1	-0.00267	0.000147	-0.002959	-0.002382	329.01	<.0001
% Hispanic	1	-0.001752	0.000206	-0.002156	-0.001347	72.06	<.0001
% African American	1	-0.002161	0.000144	-0.002442	-0.00188	226.64	<.0001
Total PPE	1	0.0001	0	0	0.0001	15.1	0.0001
Student/Teach Ratio	1	0.0036	0.0011	0.0014	0.0057	10.44	0.0012

Model for Male Proficient (Science)

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.3266	0.3732	-0.4049	1.058		0.3815
Meet HAC Rec's	1	0.0651	0.0597	-0.0518	0.182	1.19	0.2753
% Free/Red Lunch	1	-0.001716	0.000265	-0.002236	-0.001196	41.81	<.0001
% Hispanic	1	-0.001281	0.000388	-0.002042	-0.00052	10.88	0.001
% African American	1	-0.002812	0.000263	-0.003327	-0.002297	114.45	<.0001
Total PPE	1	0.0001	0	0	0.0001	1.57	0.2104
Student/Teach Ratio	1	0.0076	0.002	0.0036	0.0116	14.18	0.0002

REGRESSION RESULTS FOR FRL STUDENTS

Model for FRL Proficient (Math)

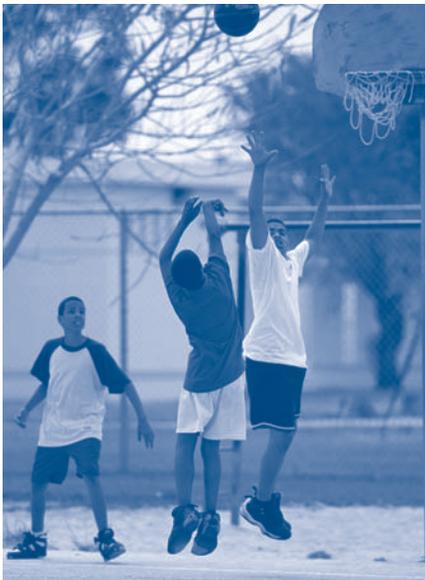
Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	-0.0025	0.2104	-0.4148	0.4098	0	0.9905
Meet HAC Rec's	1	0.0412	0.0295	-0.0166	0.099	1.95	0.1626
Student/Teach Ratio	1	0.0066	0.0011	0.0044	0.0088	35.35	<.0001
% Free/Red Lunch	1	-0.000478	0.000149	-0.000771	-0.000185	10.23	0.0014
% Hispanic	1	0.000377	0.000206	-0.000027	0.00078	3.34	0.0676
% African American	1	-0.001454	0.000144	-0.001736	-0.001172	102.19	<.0001
Total PPE	1	0.000001	0	0	0.000001	12.4	0.0004

Model for FRL Proficient (Reading)

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	-0.3349	0.227	-0.7798	0.1099	2.18	0.14
Meet HAC Rec's	1	0.081	0.0318	0.0186	0.1434	6.47	0.011
Student/Teach Ratio	1	0.0025	0.0012	0.0002	0.0049	4.41	0.0357
% Free/Red Lunch	1	-0.001324	0.000161	-0.00164	-0.001008	67.46	<.0001
% Hispanic	1	-0.001103	0.000222	-0.001539	-0.000667	24.62	<.0001
% African American	1	-0.001278	0.000155	-0.001582	-0.000974	67.83	<.0001
Total PPE	1	0.0001	0	0.0001	0.0002	20.79	<.0001

Model for FRL Proficient (Science)

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	0.0883	0.4777	-0.848	1.0246	0.03	0.8533
Meet HAC Rec's	1	0.068	0.0681	-0.0656	0.2015	0.99	0.3187
Student/Teach Ratio	1	0.0021	0.0025	-0.0029	0.0071	0.69	0.4065
% Free/Red Lunch	1	-0.001135	0.000331	-0.001783	-0.000486	11.75	0.0006
% Hispanic	1	-0.000539	0.000462	-0.001444	0.000367	1.36	0.2438
% African American	1	-0.002221	0.000315	-0.002838	-0.001604	49.77	<.0001
Total PPE	1	0.0001	0.0001	0	0.0002	1.74	0.1873



SIMPLE PPE/HAC REGRESSION

Model 1: OLS, using observations 1-8976 • Dependent variable: Meet HAC					
	Coefficient	Std. Error	t-ratio	p-value	
const	0.0793762	0.0434287	1.8277	0.06762	*
PPE_THSNDS	0.0316604	0.00535042	5.9174	<0.00001	***

Mean dependent var	0.334670
Sum squared resid	1990.882
R-squared	0.003887
F(1, 8974)	35.01521
Log-likelihood	-5977.570
Schwarz criterion	11973.35

S.D. dependent var	0.471901
S.E. of regression	0.471010
Adjusted R-squared	0.003776
P-value(F)	3.39e-09
Akaike criterion	11959.14
Hannan-Quinn	11963.98

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By Dayne Batten, Christopher Britt, Jennifer DeNeal, and Lauren Hales

The Financial and Business Services Area is in its sixth year of the Research Intern Program. The Program is designed to help build a quality research program within NCDPI to supplement and supply data for discussions related to procedural, process, and policy changes. This year's program included students from Duke University's Master of Public Policy program, The University of North Carolina at Chapel Hill's Master of Public Administration program, and North Carolina State University's Master of Public Administration program. The intern program is managed by Eric Moore (919-807-3731) and Kayla Siler (919-807-3824) | intern_research@dpi.nc.gov.

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