



The Effect of MMSD 4K Enrollment on Kindergarten Outcomes

Key Findings

1. Holding demographic characteristics constant, enrollment in MMSD 4K has a positive and statistically significant impact on students' likelihood of meeting the PALS-K Fall summed score benchmark, which indicates that students have the basic skills they need to continue learning to read.
2. Enrollment in MMSD 4K has no observable effect on first semester Kindergarten attendance or students' PALS-K summed scores overall.
3. For African-American students and students receiving free/reduced lunch, MMSD 4K enrollment has a positive and significant impact on meeting the PALS benchmark and the PALS summed score, but no effect on first semester Kindergarten attendance.

This report includes an estimation of the effect of enrollment in MMSD four-year old kindergarten (4K) on kindergarten outcomes, including literacy and attendance. MMSD implemented a universal 4K program beginning during the 2011-12 school year. Nearly 2,000 students participated in the program during 2012-13, which includes 4K sites at several MMSD elementary schools as well as many other sites throughout the community.

The report builds on [a prior report](#) created by the Research & Program Evaluation Office in the Spring of 2013 that also focused on the effect of 4K enrollment on kindergarten outcomes.

Data

To measure literacy in Kindergarten, we use the Phonological Awareness Literacy Screening (PALS). PALS-K is a statewide, mandatory universal screening assessment designed to identify students who are relatively behind in their acquisition of fundamental literacy skills. PALS-K is composed of six required tasks and one optional task, each of which provides teachers with a picture of how students are progressing in specific areas of literacy. PALS-K includes a summed score, which is benchmarked to show whether a student has the basic skills they need to continue learning to read. In 2013-14, all kindergarten students in MMSD took PALS in the fall and spring, regardless of language proficiency or disability status. This report focuses on the fall PALS-K scores and includes all students who took the PALS-K in the fall of the 2013-14 school year.

To measure attendance, we use students' attendance rate from the first semester of Kindergarten.

Summary statistics on the sample of included students appear below:

Table 1: Summary Statistics

| | Attended community 4K site | Attended school 4K site | Attended 4K in MMSD | Did not attend 4K in MMSD |
|---------------------------------------|-------------------------------|----------------------------|------------------------|------------------------------|
| Number of students | 599 | 904 | 1503 | 727 |
| Female | 47% | 50% | 49% | 51% |
| Free/reduced lunch | 54% | 52% | 53% | 42% |
| Special education | 8% | 10% | 9% | 6% |
| Single parent | 35% | 27% | 30% | 35% |
| College-educated parent | 57% | 49% | 52% | 62% |
| English Language Learner | 32% | 31% | 31% | 26% |
| Asian | 8% | 8% | 8% | 11% |
| African American | 17% | 16% | 16% | 15% |
| Hispanic | 27% | 24% | 25% | 18% |
| Two or more races | 9% | 9% | 9% | 9% |
| White | 40% | 42% | 41% | 47% |
| Other races | 0% | 1% | 0% | 0% |
| Percent meeting PALS-K Fall benchmark | 82% | 84% | 83% | 83% |
| Semester I K attendance | 94.9% | 94.4% | 94.6% | 94.9% |
| Average PALS-K Fall summed score | 56.6 | 56.8 | 56.7 | 59.6 |



Methods

The summary statistics above show that simply comparing the outcomes of students attending 4K in MMSD against those who did not is potentially misleading because these groups, while largely similar, have a few important demographic differences. For example, students not attending 4K in MMSD are more likely to be white, less likely to receive free/reduced lunch, and more likely to have parents who graduated from college with at least a bachelor's degree.

Therefore, to test the effect of MMSD 4K enrollment on kindergarten outcomes, we conducted a series of regressions to help control for demographic differences between 4K attendees and non-4K attendees.

All of the models in this report are designed to estimate the effect of attending 4K in MMSD, not the effect attending any kind of 4K program. Therefore, none of our findings should be interpreted as the effect of 4K relative to not attending 4K, as we cannot be sure whether the students not attending 4K in MMSD attended any other 4K programs, including private programs or programs in other districts.

Model 1: PALS-K Met Benchmark

The first model examines the probability of MMSD 4K enrollment on meeting the PALS-K benchmark, holding demographics constant; in other words, what are the odds that a student who enrolled in MMSD 4K would meet the PALS-K benchmark compared to students who did not enroll in MMSD 4K. To calculate this, we ran a logistic regression with PALS-K benchmark met as the binary dependent variable, MMSD 4K enrollment as the independent variable, and with a robust set of demographic characteristics as the controls.

Models 2 & 3: First Semester Kindergarten Attendance and PALS-K Scale Score

The second and third models examine the effect of 4K enrollment on attendance rates during the first semester of kindergarten and on the PALS-K Fall summed score itself, which is the measure used to determine whether students met the Fall benchmark examined through the first model. These models used robust linear regression. A typical linear regression would treat all students with equal weight, but when we used linear regressions to predict PALS-K scale scores, we found that these models tended to overpredict scores for students who scored low and underpredict scores for students who scored high. Therefore, we used robust linear regression instead, which means that students for whom the regression model more accurately predicted their attendance or PALS score received were weighted more heavily, while students whose scores or attendance were significantly over/underpredicted were weighted less heavily.

Differences from Prior Report

There are two major changes to the methodology in this report relative to the methodology used for the [prior report](#) on the effect of 4K enrollment. First, we used logistic regression instead of linear regression to estimate the effect of 4K enrollment on the likelihood of meeting the PALS-K Fall benchmark, which is more appropriate because whether a student met the benchmark is a yes/no variable. Second, we added a model (Model 2) to test if 4K enrollment is predictive of kindergarten attendance.



Findings

Table 2: Overall Regression Results

| | Model 1: PALS-K met Fall benchmark | Model 2: 1st semester Kindergarten attendance | Model 3: PALS-K Fall summed score |
|--------------------------|---------------------------------------|---|--------------------------------------|
| Regression type | Logistic | Robust linear | Robust linear |
| Enrolled in MMSD 4K | 1.71*** (0.24) | -0.17 (0.18) | 0.86 (1) |
| Female | 1.39** (0.18) | 0.05 (0.17) | 2.66*** (0.94) |
| Free/reduced lunch | 0.3*** (0.06) | -0.26 (0.24) | -13.56*** (1.3) |
| Special education | 0.22*** (0.04) | -0.53* (0.31) | -16.77*** (1.74) |
| Single parent | 0.86 (0.13) | -0.7*** (0.21) | -4.02*** (1.14) |
| College-educated parent | 1.51*** (0.23) | 0.77*** (0.21) | 9.59*** (1.13) |
| English Language Learner | 0.57*** (0.12) | 0.22 (0.28) | -8.56*** (1.55) |
| Asian | 0.56* (0.18) | 0.14 (0.37) | 2.49 (2.04) |
| African American | 0.33*** (0.08) | -0.89*** (0.29) | -7.51*** (1.61) |
| Hispanic | 0.2*** (0.05) | -0.22 (0.31) | -11.85*** (1.72) |
| Two or more races | 0.59* (0.18) | -0.55* (0.32) | -0.39 (1.77) |
| Constant | 21.05 | 95.93 | 66.2 |

Note: Statistically significant coefficients bolded for emphasis, *= $p < 0.10$, **= $p < 0.05$, ***= $p < 0.01$

The coefficients on the first model are odds ratios. In this model, these coefficients can be interpreted as the effect of the independent variable (in this case, attending 4K in MMSD) on the odds of meeting the PALS-K benchmark. Holding demographic factors constant, a student attending 4K in MMSD and continuing on to Kindergarten in MMSD would have odds of meeting the PALS-K benchmark 1.71 times higher than a student who did not attend 4K in MMSD but went to Kindergarten in MMSD.

The coefficients on the second and third models can be interpreted as the effect of 4K enrollment in MMSD on first semester kindergarten attendance and on the PALS-K summed score, respectively. For example, a student attending 4K in MMSD would be expected to have 0.17% lower attendance and a PALS scale score 0.86 points higher than their non-attending peers; because neither effect is statistically significant, though, these differences are likely random and should effectively be interpreted as negligible.

Although it may appear contradictory that attending 4K in MMSD appears to have a significant effect on the likelihood of meeting the PALS-K Fall benchmark but no significant effect on PALS-K summed scores, these two findings are not incompatible. The PALS-K Fall benchmark is 28, but the maximum score is 102, so there can be significant variation in student scores above the benchmark. A finding of increased likelihood of meet the benchmark but no significant score increase could imply, for example, that attending 4K in MMSD makes students more likely to meet the benchmark of 28 if their scores are on the lower end of the possible range but does not have a large effect for students who score far above the benchmark.



Students enrolling in MMSD 4K can attend either a site located at an MMSD school or a site located elsewhere in the community. To test for a differential effect between MMSD sites and community sites, we conducted the same regressions again, substituting a categorical variable representing the type of 4K site attended for the binary variable that indicated 4K enrollment in the earlier models.

Table 3: MMSD School versus Community 4K Sites

| | Model 1: PALS-K met Fall benchmark | Model 2: 1st semester Kindergarten attendance | Model 3: PALS-K Fall summed score |
|----------------------------|---------------------------------------|--|--------------------------------------|
| Regression type | Logistic | Robust linear | Robust linear |
| Enrolled 4K community site | 1.66*** (0.28) | 0.16 (0.22) | 1.09 (1.22) |
| Enrolled 4K school site | 1.75*** (0.27) | -0.4** (0.2) | 0.69 (1.11) |
| Female | 1.39** (0.18) | 0.07 (0.17) | 2.67*** (0.94) |
| Free/reduced lunch | 0.31*** (0.06) | -0.27 (0.24) | -13.57*** (1.3) |
| Special education | 0.22*** (0.04) | -0.5 (0.31) | -16.78*** (1.74) |
| Single parent | 0.87 (0.13) | -0.73*** (0.21) | -4.05*** (1.15) |
| College-educated parent | 1.52*** (0.23) | 0.72*** (0.21) | 9.56*** (1.14) |
| English Language Learner | 0.57*** (0.12) | 0.2 (0.28) | -8.57*** (1.55) |
| Asian | 0.56* (0.18) | 0.16 (0.37) | 2.49 (2.05) |
| African American | 0.33*** (0.08) | -0.9*** (0.29) | -7.52*** (1.62) |
| Hispanic | 0.2*** (0.05) | -0.24 (0.31) | -11.87*** (1.73) |
| Two or more races | 0.59* (0.18) | -0.59* (0.32) | -0.39 (1.77) |
| Constant | 20.94 | 95.97 | 66.25 |

Note: Statistically significant coefficients bolded for emphasis, *=p<0.10, **=p<0.05, ***=p<0.01

Again, the coefficients on the first model are odds ratios, while the coefficients on the second and third models are interpreted as changes in the dependent variable.

There is little observable difference between community and MMSD 4K sites in terms of the increased likelihood of meeting the PALS-K benchmark. In addition, 4K attendance at either type of site was not particularly predictive of first semester Kindergarten attendance or PALS-K Fall summed scores, with the exception that attending 4K at an MMSD school site actually appears to be a negative predictor of kindergarten attendance with 95% confidence. However, the magnitude of that effect is only about 0.4 percentage points.



Finally, we replicated the second set of regression models to see if 4K enrollment appears to have differential effects for African-American students (Table 4) or students receiving free/reduced lunch (Table 5).

Table 4: African-American Students Only

| | Model 1: PALS-K met Fall benchmark | Model 2: 1st semester Kindergarten attendance | Model 3: PALS-K Fall summed score |
|----------------------------|---------------------------------------|--|--------------------------------------|
| Enrolled 4K community site | 2.09** (0.72) | 0.82 (0.78) | 8.12*** (3.15) |
| Enrolled 4K school site | 1.97** (0.62) | 0.15 (0.71) | 9.47*** (2.9) |
| Female | 1.22 (0.33) | -0.29 (0.6) | 4.17* (2.45) |
| Free/reduced lunch | 0.61 (0.27) | 1.31 (0.88) | -7.73** (3.56) |
| Special Education | 0.14*** (0.06) | 0.62 (1.05) | -25.51*** (4.27) |
| Single parent | 0.76 (0.24) | -1.45** (0.68) | -5.61** (2.78) |
| College-educated parent | 1.26 (0.4) | 1.16* (0.68) | 1.51 (2.75) |
| English Language Learner | 2.41 (1.87) | 1.89 (1.21) | 12.1** (4.91) |
| Constant | 3.94 | 93.03 | 49.8 |

Note: Statistically significant coefficients bolded for emphasis, *= $p < 0.10$, **= $p < 0.05$, ***= $p < 0.01$

Table 5: Students Receiving Free/Reduced Lunch Only

| | Model 1: PALS-K met Fall benchmark | Model 2: 1st semester Kindergarten attendance | Model 3: PALS-K Fall summed score |
|----------------------------|---------------------------------------|--|--------------------------------------|
| Enrolled 4K community site | 1.5** (0.29) | -0.03 (0.37) | 3.8** (1.84) |
| Enrolled 4K school site | 1.53** (0.27) | -0.55 (0.35) | 4.85*** (1.72) |
| Female | 1.21 (0.18) | 0.27 (0.29) | 2.94** (1.41) |
| Special Education | 0.19*** (0.04) | -0.43 (0.47) | -17.78*** (2.3) |
| Single parent | 1.01 (0.16) | -0.51* (0.31) | -0.89 (1.52) |
| College-educated parent | 1.34* (0.22) | 0.44 (0.31) | 6.25*** (1.55) |
| English Language Learner | 0.56** (0.14) | 1.75*** (0.51) | -6.74*** (2.52) |
| Asian | 0.55 (0.23) | -1.02 (0.74) | -8.18** (3.63) |
| African-American | 0.34*** (0.1) | -0.83* (0.44) | -12.33*** (2.18) |
| Hispanic | 0.21*** (0.07) | -1.32** (0.57) | -18.57*** (2.83) |
| Two or more races | 0.52* (0.19) | -1.2** (0.56) | -8.32*** (2.78) |
| Constant | 7.16 | 95.28 | 54.18 |

Note: Statistically significant coefficients bolded for emphasis, *= $p < 0.10$, **= $p < 0.05$, ***= $p < 0.01$

For African-American students and students receiving free or reduced lunch, enrollment in MMSD 4K appears to be predictive of both a higher likelihood of meeting the PALS-K Fall benchmark and a higher PALS-K Fall summed score. Results are similar for community and MMSD school 4K sites. Enrollment in MMSD 4K does not appear to be predictive of first semester Kindergarten attendance for either group.