CROCUS Working Paper #23

September 2020

Does attending pre-K or Head Start predict high school graduation?

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Abstract

Studies have found favorable associations of early childhood education (ECE) programs with high school graduation; much of this research was conducted on targeted programs and when families had fewer options. The present study builds upon this literature to examine the impacts of a universal pre-K and Head Start program in Tulsa, OK. The sample includes 2,516 students (33% Black, 23% Hispanic, 10% Native American, 33% White; 49% female students). Data were from the Tulsa Public Schools, a parent survey, and the Oklahoma State Department of Education. Results indicate that attending pre-K but not Head Start was marginally or significantly associated with high school graduation, depending on how it was operationalized. Findings have implications for pre-K program expansion and research.

Does attending pre-K or Head Start predict high school graduation?

Approximately 3.6 million students graduate from high school each year. The earning power of high school graduates substantially exceeds that of high school dropouts (Autor, Katz, & Kearney, 2008). The overwhelming majority of students graduate from high school, and the overwhelming majority graduate on-time, though that percentage is lower in Oklahoma, which has a higher grade-retention rate than the national average (Annie Casey Foundation, 2018). High school graduation can be affected by a variety of factors, including individual, family, school, peer, and community contexts (Zaff, Donlan, Gunning, Anderson, McDermott, Sadaca, 2017). Schools have implemented a variety of mechanisms to promote graduation, both directly in support of graduating on time, such as credit recovery, along with programs and services that support graduation more indirectly. Participating in high-quality pre-K, with demonstrated links to favorable outcomes through high school (Amadon, Gormley, Magnuson, Claessens, Hummel-Price, 2022), may also promote graduation. Accordingly, we address the question of whether participation in a high-quality, universal pre-K program can improve high school graduation rates. Using longitudinal data from over 2,500 students who entered the Tulsa Public Schools kindergarten program in the fall of 2006, and propensity score weighting, we compare high school outcomes for students who attended the Tulsa Public Schools pre-K program, students who attended the CAP of Tulsa County Head Start program, and students who attended neither program. We present findings for students overall. Findings by subgroup are available on request.

Beginning in the late 1990s, state and local governments established state- or locally-funded pre-K programs, including both targeted and universal programs (Yoshikawa et al., 2013). Evaluations have proliferated, though most have focused on short-term and medium-term

impacts. In recent years, a handful of scholars have been able to estimate high school effects of contemporary pre-K programs, though high school graduation impacts have received less scrutiny than other high school outcomes, at least partly because the other high school outcomes occur sooner in the developmental cycle.

A review of the literature suggests that there are reasons to be optimistic about a possible favorable connection between pre-K and high school graduation. Studies of early childhood education (ECE) programs launched a half century ago, including the Perry Preschool Program and the Abecedarian Project, found a positive relation between pre-K and educational attainment. Perry Preschool alumni had one more year of secondary schooling and were more likely to graduate from high school (Schweinhart et al., 2013). Abecedarian Project alumni had one more year of secondary schooling and were more likely to enroll in a four-year college but were not more likely to graduate from high school (Campbell et al., 2012). A study of the Chicago Child Parent Centers (CPC) found a positive relation between pre-K and high school graduation, among other favorable outcomes (Reynolds et al., 2011). Specifically, the Chicago CPC study found that pre-K alumni were 9 percentage points more likely to have completed high school than a comparable group of non-alumni. A meta-analysis of 13 studies of early pre-K programs (five projects, including the three mentioned above) found that pre-K participation yielded a .24 SD increase in high school graduation rates (McCoy et al., 2017). But many of these studies feature programs from years ago, when counterfactual circumstances included fewer programs for young children than are available today.

Studies of contemporary pre-K programs are now reaching the point where data are available to assess high school outcomes. A study of New Jersey's targeted pre-K program found positive effects on several outcomes, as of high school or late middle school, including

positive, statistically significant effects on English Language Arts standardized tests in 10th grade (Barnett et al., 2021). Effects were larger and more persistent for students exposed to a two-year program than for students exposed to a one-year program. A study of Tulsa, Oklahoma's universal pre-K program also found positive effects on several high school outcomes, as of the end of 11th grade (Amadon et al., 2022). These outcomes included higher rates of enrollment in AP or IB courses, lower rates of course failure, and better attendance records. Both the New Jersey and Tulsa studies also found that pre-K alumni were less likely than non-alumni to have been retained in grade at some point between pre-K and the study date (10th grade, 11th grade).

Only one recent study has addressed the question of whether there is an association between pre-K and high school graduation. That study, focusing on Boston's universal pre-K program, found that pre-K enrollment increased the probability that students would graduate from a Massachusetts public high school on time by 5.4 percentage points and the probability of graduating at any time by 6.0 percentage points (Gray-Lobe et al., 2021). The same study also found an association between pre-K and SAT test taking and college enrollment, though not between pre-K and state achievement test scores. However, recent analyses of the Boston universal pre-K program through third grade found no effects on grade retention, special education placement, or third grade test scores (Weiland, Unterman, Shapiro, Staszak, Rochester, & Martin, 2020). Importantly, these two studies examined different cohorts of students, and the more contemporary study (Weiland et al., 2020) found evidence that children who applied for the pre-K lottery and attended were not representative of all children who applied.

Some scholars have cautioned that we should not expect positive long-term effects for all -- or even most -- pre-K programs. Researchers have reported rapid fadeout of the Tennessee Voluntary Pre-K program after an initial boost in test scores at kindergarten entry and found

negative results as of 3rd grade (Lipsey et al., 2018) and 6th grade (Durkin et al., 2022), with pre-K alumni faring worse on selected indicators than non-alumni. For example, as of 6th grade, pre-K alumni scored worse on standardized tests and were rated more poorly on attendance and behavior than non-alumni randomly assigned to a control group. Similarly, a national Head Start evaluation reported rapid fadeout of positive effects, across a range of indicators, including cognitive measures, socio-emotional measures, and health measures (Puma et al., 2012). However, it should be noted that some studies of Head Start have found a positive link between Head Start attendance and high school graduation (Bailey et al., 2021).

In sum, there is reason to suspect that attending pre-K and Head Start may be associated with a greater likelihood of high school graduation. Studies of local, state, and national pre-K programs (including Head Start) demonstrate relatively consistent evidence that pre-K is associated with at least short-term and to a lesser extent longer-term outcomes. We extend this literature to consider high school graduation for pre-K and Head Start alumni with a sample of over 2,500 students in Tulsa, OK. Of note, the Head Start sample size is smaller than the TPS pre-K sample size, making it more difficult to discern statistically significant effects among these students.

Method

Participants

The present study follows participants from their pre-K (2005-06) or kindergarten year (2006-07) through high school. In 2006-07, 4,033 students were enrolled in a TPS kindergarten program. Of those, 40% attended the public universal pre-K program and 11% attended the CAP Head Start program, which also receives state funds. The remaining kindergarteners were in neither pre-K nor Head Start, although it is possible that they attended another ECE setting

during the year prior to kindergarten. Consistent with prior studies of these programs in Tulsa (e.g., Amadon et al., 2022), our analytic strategy was to compare pre-K and Head Start students (separately) with the universe of students who were not in either pre-K or CAP Head Start. Table 1 displays the kindergarten year demographic characteristics of the original cohort of 4,033, and by pre-K, CAP Head Start, and control group status.

Procedures

Students were identified in Tulsa Public Schools (TPS) in 2006-07 and, later, Oklahoma State Department of Education (OSDE) records through the end of high school. Parents also completed a survey in the fall of 2006. Approximately 64% of parents of the original sample completed the survey, answering questions about educational attainment, marital status, resources in the home, and prior child care arrangements, among other characteristics.

Measures

The two independent variables of interest are whether a student attended TPS pre-K and Head Start programs in 2005-06. TPS administrative data were used to identify whether students attended pre-K or Head Start for at least 50% of the academic year prior to kindergarten (1=yes; 0=no).

The key dependent variable was high school graduation, which we operationalized in four different ways. The first two variables focus on graduation at any point during a students' educational career; the second two focus on on-time graduation:

1. OSDE provided an indicator of graduation status (yes/no; 1/0) as well as details about students' reasons for exiting the school district. The first operationalization of graduation is simply to use the original OSDE graduation indicator. However, this indicator categorized those students who transferred out of state, transferred to homeschooling,

were incapacitated, or whose exit detail was coded as "non-graduates" even though their final disposition was unclear.

2. Given the limitations of the first variable, we created a second measure of graduation that excluded students for whom we did not observe whether they graduated from high school (including those who moved out of state, transferred, or were incapacitated).

Another measure of student success in high school is graduating on-time. We operationalized on-time graduation two ways:

1. When a student enters high school, he/she is assigned a cohort year. If the student graduated with their cohort, he/she would be considered an on-time graduate.
2. When students enter kindergarten, they also are given a cohort year. These students could be retained in grade prior to and/or during high school. This second measure of on-time graduation only categorizes students as on-time graduates if they graduated with their original kindergarten cohort; all others are in the not-on-time graduation group (even those who graduated but did so late).

Covariates. The parent survey administered in kindergarten captured information about parental marital status, whether the child currently lived with his or her biological father, the highest level of education attained by the child's mother, the primary language spoken at home, and the availability of internet access at home. TPS data from the kindergarten year provided information about age, gender, race/ethnicity, and whether he or she received a reduced or free lunch (an indicator of socioeconomic status). We used measures of the families' census block group median income in kindergarten, representing neighborhood economic resources with data from the American Community Survey from 2010.

Analytic Strategy

We used multiple imputation to impute the survey variables used as covariates and used school administrative data (none of which was missing), including gender, race/ethnicity, neighborhood median income, free lunch status, and age to inform imputation models. We utilized the Stata mi impute chained command to impute survey variables and generated 40 multiply imputed datasets.

A robust set of covariates were used in propensity score modeling to generate weights for outcome analyses that balance treatment and comparison group participants. Analyses were done comparing pre-K to non-pre-K (excluding Head Start) and Head Start to non-Head Start (excluding pre-K). We modeled our analytic strategy on prior analyses of this sample in high school (Amadon et al., 2022). We used a comprehensive set of covariates to predict whether or not a student attended pre-K (yes/no; 1/0) and then used students' observed covariate values to obtain a predicted probability of attending pre-K. We used boosted logistic regression modeling techniques, which utilizes a machine learning approach, to estimate the propensity scores (specifically the TWANG package; McCaffrey, Ridgeway, & Morral, 2004). We selected iterations, non-linearities, and interactions to optimize the model and minimize the absolute standardized difference (ASD) between the treatment and control cases (the difference in means for each covariate divided by the pooled standard deviation).

We gave a weight of one to treatment participants and a weight equal to the predicted odds of being in a treatment case to the comparison group ($[\rho_i / (1- \rho_i)]$; Hirano, Imbens, & Ridder, 2003). This weighting strategy up-weights the comparison participants whose observed covariate values best match those of treatment participants and down-weights participants whose observed covariate values are *least like* those of treated participants. Propensity score modeling was conducted separately for each multiply imputed dataset. The same process was used to

generate propensity scores for Head Start students.

Outcome analyses involved weighted multiple regression with covariates. We estimated linear probability models (LPMs); coefficients from LPM give the percentage-point increase in likelihood of graduation. Covariates included race/ethnicity, maternal marital status and education, free lunch status, gender, internet access at home, neighborhood median income, and living with father in kindergarten.

Results

Table 1 includes the means, standard deviations, and proportions of covariates, independent, and dependent variables, by treatment status.

Outcome analyses revealed significant associations between attending TPS pre-K, but not Head Start, and high school graduation (see Table 2). Attending pre-K was marginally associated with graduation as conceptualized by OSDE, both by the original classification and after excluding students who moved or otherwise were not observed as graduating or not.

Attending pre-K also was significantly associated with kindergarten-cohort on-time high school graduation and marginally associated with high school-cohort on-time graduation. Students who attended TPS pre-K were 8 percentage points more likely to graduate from high school on-time (using kindergarten-cohort graduation) and 2.5 percentage points more likely to graduate from high school.

On the other hand, attending Head Start did not significantly predict high school graduation status of any kind. There was no discernible difference in the likelihood of graduation between Head Start and comparison group students.

Discussion

In the present study, we examined the association between attending pre-K and Head

Start with high school graduation, as conceptualized in several different ways. The evidence linking ECE with positive elementary, middle, and high school outcomes is relatively robust, but few studies have examined high school graduation. We focused on a longitudinal cohort of 2,516 students in Tulsa, OK followed through high school. Although students were not randomly assigned to pre-K, Head Start, or neither condition, we used quasi-experimental techniques, including propensity score weighting, to mitigate selection bias.

Results suggest that attending pre-K, but not Head Start, was significantly associated with a higher likelihood of graduating from high school on time; however, attending pre-K was only marginally associated with high school graduation as conceptualized by OSDE or with on-time high school cohort graduation. Importantly, the significant association between pre-K and on-time high school graduation includes in the comparison group those students who graduated but graduated a year late from what their kindergarten cohort would predict. Thus, it combines grade retention at any time during school with graduation. Grade retention can have deleterious consequences for later behavior and academic achievement. However, in the present study, those students who were grade retained also could have graduated (though one or more years behind). Indeed, of the 414 students who did not graduate on time, 60 of them (14%) did eventually go on to graduate; the remainder either dropped out, graduated more than one year behind schedule, or are otherwise unaccounted for in OSDE data. These findings alone point to the potential negative consequences of grade retention for high school graduation.

Results are in line with previous research on high school outcomes with this cohort of Tulsa students. Students who attended TPS pre-K were significantly less likely to be grade retained, were absent fewer days (and less likely to be chronically absent), and less apt to fail a course; they also were more likely to take an Advanced Placement course (Amadon et al., 2022).

Head Start students also missed fewer days of school, but Head Start attendance was not significantly associated with other outcomes. In short, pre-K was associated with a wider variety of high school outcomes; these outcomes in turn may be more predictive of on-time high school graduation. Related research finds that high school outcomes, including chronic absenteeism and course failure, predict a lower likelihood of high school graduation (Mac Iver & Messel, 2013; Marshall, 2022), which would imply that the pre-K sample would also be more likely to graduate and graduate on time from high school than the Head Start sample, via improved high school outcomes. That Head Start alumni did not demonstrate favorable high school graduation outcomes may not be surprising in this context.

It is important to interpret these findings in the context of Tulsa pre-K. The Tulsa pre-K program is notable for its structural indicators of quality, including low student-to-teacher ratios, relatively high teacher educational requirements, and small class sizes (Friedman-Kraus et al., 2022). Related research on classroom quality experienced by this sample demonstrated that process measures of quality, such as instructional support, classroom organization, and time spent on literacy and math activities were higher in Tulsa pre-K classrooms than in other school-based preschool classrooms in other states (Phillips, Gormley, & Lowenstein, 2009). The early experiences in pre-K appear to have persisted through elementary, middle, and high school (Gormley & Gayer, 2005; Hill, Gormley, & Adelstein, 2015; Phillips, Gormley, & Anderson, 2016). On-time high school graduation results appear to have been the last in a chain reaction of early student achievement and engagement in school that then translated into higher rates of high school graduation. However, results should not be generalized to all pre-K programs in the U.S. Oklahoma's school-based pre-K tends to be of higher quality than other state programs, as discussed. Pre-K in Oklahoma is also largely based in schools and is universal, with any student

gaining access if their parents choose. However, results from this sample continue to point to the promise of public pre-K in enhancing student outcomes, which translates to on-time high school graduation.

As discussed, the lack of associations for Head Start also may not be surprising given prior results with this sample. It also should be noted that the sample size of students who attended Head Start was approximately one fourth the size of the pre-K and comparison groups, leading to less statistical power in detecting significant effects. Other research on Head Start with a national sample has demonstrated important and significant associations with a range of outcomes, with important policy-relevant subgroups of students, and when carefully considering the comparison group (Morris et al., 2018). Head Start impacts also go beyond children, given its wraparound services, and include favorable consequences for parents (e.g., Padilla, 2020; Sabol & Chase-Lansdale, 2015). This is especially true of Tulsa's Head Start program, which features free vocational training to a significant number of parents.

Limitations

Limitations should be noted. The present study used a quasi-experimental design, rather than a lottery-based or experimental design. Parents opted to enroll their children in pre-K or Head Start. We controlled for a variety of child, parent, and community characteristics, but there could be other features, beyond and uncorrelated with those we observed, that could explain pre-K enrollment and high school graduation. Attrition was also a problem. Not all students stayed in Tulsa or Oklahoma; however, we used OSDE data to capture the graduation experiences of all students who remained in Oklahoma and were in a public high school. Finally, we should note that our grade-retained students experienced the COVID epidemic during the final three months of their senior year (2019-2020), which could potentially inflate their high school graduation

rates slightly if principals and teachers treated the epidemic as an extenuating circumstance. If so, our program impact estimates would be underestimates, because a disproportionate share of control group students were grade-retained.

Conclusion

For over twelve years, our research group has been following a cohort of students from Tulsa's pre-K program through high school graduation. We have consistently documented practical and important differences between those students who attended Tulsa's school-based pre-K program and those who did not. We find such positive effects here as well, most notably for on-time high school graduation. Head Start effects were not detected in the present study, but the small sample size may have hampered our ability to detect associations.

Results from this sample have reliably demonstrated that engaging children in free and high quality ECE experiences can have lasting impacts. In an era of growing access to pre-K (despite recent setbacks in terms of COVID-19), future research should expand from efficacy studies to understanding related consequences for families, how teachers can best support children, and how elementary education may need to shift curricula and expectations with students entering kindergarten with additional skills and experiences, among other research priorities. Should the political winds shift in the U.S., enabling public pre-K to expand nationally, then teachers, administrators, and parents need additional guidance about how best to equip classrooms and support parents and children.

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Table 1: Descriptive characteristics (proportions, means, and standard deviations) of study sample by pre-K and Head Start status

	Pre-K	Head	Control
Graduation status			
OK definition	87%	84%	84%
OK definition, missing corrected	89%	86%	86%
On time with 9th grade cohort	86%	81%	83%
On time with K cohort	71%	61%	63%
Race			
White	32%	9%	40%
Black	37%	40%	26%
Hispanic	21%	43%	20%
Asian/Hawaiian	1%	1%	1%
Native American	9%	7%	12%
Mom Marital Status			
Never Married	25%	30%	27%
Married	58%	54%	50%
Remarried	2%	2%	3%
Separated	5%	7%	5%
Divorced	8%	6%	13%
Widowed	1%	1%	2%
Mom Education			
No high school/GED	18%	27%	18%
High school/GED	27%	33%	24%
Some college	42%	30%	42%
College degree	13%	11%	16%
Lunch Status			
Free lunch	64%	87%	62%
Reduced price lunch	13%	7%	11%
Full priced lunch	23%	6%	27%
Female	49%	49%	48%
Internet at home	55%	34%	52%
Lives with father	63%	63%	56%
Neighborhood income (in $10,000)	3.73 (1.60)	3.43 (1.30)	3.99 (2.00)
N	1373	364	1532

Table 2: Coefficients (and standard errors) of the relation between ECE programs and high school graduation

	Graduation Outcome			
Predictor	Graduate (original OSDE)	Graduate (modified OSDE)	9th grade cohort graduation	K cohort graduation
Pre-K	.03*	.025*	.028*	.08***
	(.016)	(.015)	(.016)	(.021)
Head Start	.008	.006	-.019	.018
	(.03)	(.03)	(.032)	(.039)

*Note. Control variables included listed in text. Comparisons are pre-K to the control group and Head Start to the control group. Ns vary by outcome variable from 2,189 to 2,211 for the pre-K comparison, and from 1,329 to 1,370 for the Head Start comparison. Results combined across 40 imputed data sets. ***p < .01, **p < .05, *p < .10*