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FULL REPORT:

# Attrition of Newly Recruited K-12 Teachers in Pennsylvania: From 2011/2012 to 2017/2018

Claire Allen-Platt, Sangbaek Park, Jimin Oh,
Selene S. Lee, Robert Boruch

Co-Principal Investigators: Selene S. Lee, Robert Boruch

Graduate School of Education | University of Pennsylvania

RECIPIENT OF THE
Education Research and Evaluation Scholar Award
from the Pennsylvania Department of Education (PDE)

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Research and Evaluation

OCTOBER 2019

# Abstract

The following study uses survival analysis and longitudinal administrative records from the Pennsylvania Department of Education to investigate the attrition of K-12 teachers in the state's public schools, including charter schools. Survival curves were plotted across time to show the percentage of teachers that still taught full-time at the school where they were first hired, and the Cox proportional hazard model was used to identify risk and protective factors associated with teacher attrition. After 4.8 years, approximately half of newly hired teachers ceased to teach full-time at the school where they were first hired. In addition, salary, professional development, and school size were found to be protective factors, while having a doctoral/specialist degree and teaching in a school with more minority students were found to be risk factors associated with teacher attrition.

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The Pennsylvania Department of Education (PDE) Evaluation and Research project is an effort that was established through a State Longitudinal Data System (SLDS) Grant from the Institute of Education Sciences (IES), National Center for Education Statistics (NCES), awarded in October 2015. The Research and Evaluation project is an initiative to make full use of the P-16+ system data and other data sources to answer priority questions from the PDE research agenda, to form collaborative research partnerships, and to increase PDE's capacity to conduct research. Our mission is to evaluate and analyze data to provide insight that can be used to positively impact policy, inform decision making and lead to improved student outcomes.

**Julie Patton** | SLDS Grant Manager | PDE Project Manager
Phone: 717.346.1085 | jupatton@pa.gov

**Candy M. Miller** | Research and Evaluation Manager
Phone: 717.705.6499 | c-candmill@pa.gov

Office of Data Quality | Pennsylvania Department of Education | Office of Administration
333 Market Street | Harrisburg, PA 17126-0333
Phone: 717.705.6499 | Fax: 717.787.3148

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> One index of instability in schools is the proportion of teachers that leave their school each year.

## Introduction

Research suggests that stability is a precondition for successful learning in public schools, while disruptions of many kinds are associated with adverse student outcomes. For example, students in grade levels with higher teacher turnover receive lower scores on standardized achievement tests than their counterparts in other grades (Ronfeldt, Loeb, & Wyckoff, 2013); teachers who are hired after the start of the school year are associated with lower student standardized test scores (Papay & Kraft, 2016), as are teachers who switch the grade they teach from year to year (Blazar, 2015) or experience other types of within- or between-school reassignments (Atteberry, Loeb, & Wyckoff, 2017). Conversely, research suggests that schools with orderly learning environments in which staff feel safe both retain a greater proportion of educators and report accelerated student learning gains (Borman & Dowling, 2008; Kraft, Marinell, & Yee, 2016).

One index of instability in schools is the proportion of teachers that leave their school each year. The departure could be to another school, district, or state, or to another profession altogether. The following study investigates the school-level retention of K-12 teachers in public schools (including charter schools) in Pennsylvania by identifying, over time, the proportion of teachers that no longer teach full-time in the school where they were first hired. The study also employs survival analysis, a statistical method used to analyze factors associated with a higher or lower risk of an event happening (Allison, 2010), in this case, the event of a teacher ceasing to teach full-time in the school where he or she was first hired. The results of this study can shed light on policy levers that the Department of Education of Pennsylvania can use to potentially increase the retention of teachers in K-12 public schools in Pennsylvania.

# Literature Review

Teacher attrition at the school level – that is, the proportion of teachers that leave the school in which they work – varies substantially across schools, districts, and states, and it also depends on the estimation procedure. Teachers' motivations for leaving a school also varies by age and experience. Due to the limitations of the dataset (explained in detail below), this research focused on newly hired teachers, most of whom were below the age of retirement.

Cross-sectional studies conducted by the National Center for Education Statistics (e.g., the Schools and Staffing Survey, the National Teacher and Principal Survey, the Teacher Follow-up Survey, the Beginning Teacher Longitudinal Study) suggested that at the national level, between 30% to 50% of new or beginning teachers left their school or profession within five years of recruitment (Gray & Taie, 2015; Ingersoll, 2001). A recent study by Papay, Bacher-Hicks, Page, and Marinell (2017), pooling administrative records from 16 large urban school districts in seven states, estimated that 70% of new teachers in urban settings left their initial school of hire within five years. The study documented substantial between-district variation underlying the cumulative estimate, reporting that 22% to 54% of new teachers left their school after one year of teaching, and that 62% to 81% left their school after five years of teaching (Papay et al., 2017). Regardless of the specific retention estimate, research consistently found that schools with a high concentration of students in poverty, or otherwise classified as high-needs, were disproportionately affected by a high turnover rate among newly hired teachers (Blazer, 2015; Clotfelter, Ladd, & Vigdor, 2005; Goldhaber, Gross, & Player, 2011; Guarino, Santibanez, & Daley, 2006; Hanushek, Kain, and Rivkin, 2001; Ingersoll, 2001; Lankford, Loeb, & Wyckoff, 2002; Papay & Kraft, 2016; Redding & Henry, 2018; Ronfeldt, Loeb, & Wyckoff, 2013; Steele et al., 2015).

... At the national level, between 30% to 50% of new or beginning teachers left their school or profession within five years of recruitment.

(Gray & Taie, 2015; Ingersoll, 2001)

Research using administrative records from specific states produced estimates of the teacher turnover rate that varied to a lesser degree than the national-level estimates. Many studies suggested that the level of instability among the teacher workforce was high, especially in urban districts.[5] For example, Rayes, Oh, Lee, and Boruch (2016) calculated that 42% of all teachers in Minnesota were no longer teaching in the same school after a five year period, while Chao, Park, and Boruch (2016) calculated that 45% of all teachers in Illinois were no longer teaching in the same school after a five year period. Frisone et al. (2016) calculated that one in five teachers leave an Arkansas public school each year, on average, with 53% of all teachers no longer working in the same school after five years, and higher turnover in the state's three largest districts. Ye et al. (2016) calculated that 40% of all teachers in New Jersey were no longer in the same school after a five-year period, with the cities of Newark and Camden experiencing the highest teacher mobility. Estimates of three- and five-year teacher turnover rates

5 Note that each study uses slightly different methodology. Some studies count all teachers employed in the state in the base year as the base cohort; others use similar methodology to the present study, and count only newly hired teachers; and some studies collect one teacher dataset annually, while others, such as this analysis, have continuous data on start and leave dates to calculate retention and attrition.

at the school level in the state of New York state ranged from 54% to 60% (Boyd et al., 2002; Lankford, Loeb, & Wyckoff, 2002; Papay et al., 2017), and in New York City, these estimates ranged from 51% to 66% (Boyd et al., 2008; Marinell & Coca, 2013). In Chicago, Allensworth, Ponisciak, and Mazzeo (2009) estimated a five-year school-level teacher turnover rate of 66% and 63% among new teachers in elementary and high schools, respectively. Although research on teacher mobility across states is limited, existing research suggested that there was a low level of movement across state lines, even for teachers who resided near state borders (Goldhaber et al., 2015). Teachers' investments in state-specific licensure and certification, in addition to a pension system and seniority system that reward in-state employment fidelity may disincentivize the mobility of teachers across states (Goldhaber et al., 2015; Goldhaber, Grout, & Holden, 2017).

In Pennsylvania, as in other states, mobility is high in its largest urban district. Sutcher, Darling-Hammond, and Carver-Thomas (2016) estimated an annual teacher turnover rate of 9.3% for Pennsylvania, based on data from the federal Teacher Follow-up Survey of 2013. Steinberg et al. (2018), focusing on the School District of Philadelphia, estimated that the average mobility rate among first-year teachers was above 50% in the study period from the 2009-2010 academic year to the 2015-2016 academic year, although the annual mobility rates varied each year. This suggested that school closings or specific budget shortfalls could increase or decrease the teacher mobility rates by up to ten percentage points from one year to the next. A report by the *Philadelphia Inquirer* found that in 26 schools in the School District of Philadelphia, at least 25% of the teachers had been replaced every year from the 2012-2013 academic year to the 2015-2016 academic year (Calefati, Purcell, & Graham, 2019). A study focusing on a previous period, from the 1999-2000 academic year to the 2005-2006 academic year, estimated that 80% of newly hired teachers in the School District of Philadelphia left their school of employment after five years (Useem, Offenberg, & Farley, 2007). In sum, although teacher mobility varied by location, the turnover among both new and experienced teachers appeared to be high in districts and states across the country.

The rates at which teachers leave their school assignment is a policy concern to state education agencies, because the adverse effects of teacher attrition are manifold. Reduced student achievement has been associated with several aspects of teacher workforce instability, including the hiring of teachers after the start of the school year (Papay & Kraft, 2016); the reassignment of teachers to a different grade, subject, or school (Atteberry, Loeb, & Wyckoff, 2017; Blazar, 2015); and the departure of teachers from the school in which they work (Ronfeldt, Loeb, & Wyckoff, 2013). Recruitment and staffing activities cost districts both money and time, especially when replacing teachers in hard-to-staff grades or subjects (Carver-Thomas & Darling-Hammond, 2017; Papay & Kraft, 2016); Carver-Thomas and Darling-Hammond (2017) estimated that urban districts specifically spent in excess of $20,000 for each teacher they replace. The destabilizing effect of teacher departures on a school's climate and community for adults and students is a concern (Carver-Thomas & Darling-Hammond, 2017; Ronfeldt, Loeb, & Wyckoff, 2013). Also, as states and districts strive to make evidence-based decisions, turnover can undermine knowledge about what works. Boruch et al. (2016)

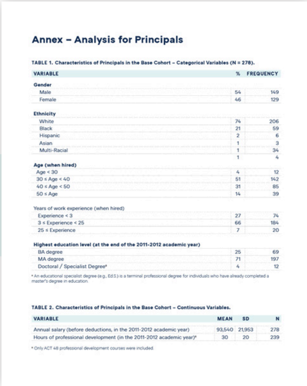
shed light on the relationship between teacher attrition and the evaluation of educational interventions, calling teacher instability "a silent but crucial factor in an intervention's potential effectiveness," because it becomes problematic to estimate the effects of educational interventions when high numbers of teachers leave a study before outcomes can be measured (Boruch et al., 2016, p. 4).

Although this body of evidence suggests that much about teacher turnover is detrimental, it is important to note that some degree of turnover is to be expected or even desired. Older members of the teacher workforce outnumber younger counterparts (Ingersoll, 2001), and retirement is a standard and reasonably forecastable phenomenon (Carver-Thomas & Darling-Hammond, 2017; Steinberg et al, 2018). Even when teachers leave for preretirement reasons, not all personnel loss have adverse effects on workforce quality. Some departures are "necessary and beneficial" (Ingersoll, 2003, p. 12; Steinberg et al., 2018), and several studies report that less effective teachers are more likely to leave their jobs than highly effective teachers (Goldhaber, Gross, & Player, 2011; Hanushek, Rivkin, & Schiman, 2016; Redding & Henry, 2018). At least one study has demonstrated that districts are able to replace leavers with more effective teachers, particularly when the leaver is induced to exit on poor performance grounds (Adnot et al., 2017). Further research is necessary to understand the net effects of teacher turnover, especially at the high magnitudes documented at the city, state, and national levels summarized above.

Recognizing the Pennsylvania Department of Education (PDE)'s need to estimate teacher turnover more accurately, the following study uses administrative records to describe and analyze attrition among newly hired teachers in K-12 public schools in Pennsylvania. Specifically, the study addresses the following questions:

1. What is the median length of time a teacher is employed in the same school?[6]
2. Is there a relationship between professional development and teacher retention? What factors lead to increased retention for teachers?

While this report focuses on teachers, attrition among principals was also analyzed, and the results are presented in the annex.



Annex – Analysis for Principals

TABLE 1. Characteristics of Principals in the Base Cohort – Categorical Variables (N = 278).

| VARIABLE | % | FREQUENCY |
|---|---|---|
| **Gender** | | |
| Male | 54 | 149 |
| Female | 46 | 129 |
| **Ethnicity** | | |
| White | 74 | 206 |
| Black | 21 | 59 |
| Hispanic | 2 | 6 |
| Asian | 1 | 3 |
| Multi-Racial | 1 | 34 |
| | 1 | 4 |
| **Age (when hired)** | | |
| Age < 30 | 4 | 12 |
| 30 ≤ Age < 40 | 51 | 142 |
| 40 ≤ Age < 50 | 31 | 85 |
| 50 ≤ Age | 14 | 39 |
| Years of work experience (when hired) | | |
| Experience < 3 | 27 | 74 |
| 3 ≤ Experience < 25 | 66 | 184 |
| 25 ≤ Experience | 7 | 20 |
| **Highest education level (at the end of the 2011-2012 academic year)** | | |
| BA degree | 25 | 69 |
| MA degree | 71 | 197 |
| Doctoral / Specialist Degree* | 4 | 12 |

* An educational specialist degree (e.g., Ed.S.) is a terminal professional degree for individuals who have already completed a master's degree in education.

TABLE 2. Characteristics of Principals in the Base Cohort – Continuous Variables.

| VARIABLE | MEAN | SD | N |
|---|---|---|---|
| Annual salary (before deductions, in the 2011-2012 academic year) | 93,540 | 21,953 | 278 |
| Hours of professional development (in the 2011-2012 academic year)* | 30 | 20 | 239 |

* Only ACT 48 professional development courses were included.

For principal data and graphs, see the annex beginning on page 30.

# Data

## *Teacher-level data*

**Data source.** Teacher-level data were obtained from various databases maintained by PDE. Information on teachers' background characteristics as well as details on their contract was obtained from the Pennsylvania

6 Calculating the mean survival time of teachers in the base cohort would be meaningless, because the maximum survival time was capped at seven years.

Information Management System (PIMS) Staff dataset, information on teachers' assignments was obtained from the PIMS Assignment dataset, and information on teachers' professional development was obtained from the Professional Education Record Management System (PERMS).[7] Each teacher had a unique ID number in these datasets, making it possible to link their data across the different datasets as well as across the different academic years. These datasets were updated on June 30 of each year, and data from the 2011-2012 academic year to the 2017-2018 academic year were included in the analysis.[8]

**Teachers included in the base cohort.** The base cohort included teachers who were newly hired by a K-12 public school in Pennsylvania during the 2011-2012 academic year and taught full-time in only one school that year. Teachers in the dataset who had been hired before the 2011-2012 academic year were not included in the study, because this would have over-estimated the overall survival times of teachers, because the analysis would not have taken into account the survival times of the teachers who had left the teaching profession before the beginning of the 2011-2012 academic year. In other words, the analysis would have excluded teachers whose survival times were shorter than the survival times of teachers that were still teaching in the 2011-2012 academic year.

In order to identify teachers in the base cohort, first, staff whose contract started during the 2011-2012 academic year (i.e., between July 1, 2011 and June 30, 2012) were identified. After excluding staff hired by private schools, staff that were indicated as working full-time in the 2011-2012 PIMS Staff dataset were identified. Subsequently , for each individual in this subset, all of his or her teaching assignments (excluding any assignments in special education programs or administrative assignments) in the 2011-2012 PIMS Assignment dataset were identified, and the proportion of time assigned (PTA) to these teaching assignments were summed for each school that the individual worked in. Lastly, only the individuals whose summed PTA for the teaching assignments was at least 100 in a school were included in the final subset of teachers. Thus, individuals who worked full-time in one school but did not teach full-time for that school (e.g., the individual's responsibilities were split between teaching and administrative assignments) were not included in the base cohort. As a result, 3,947 teachers were identified for the base cohort.

**Descriptive statistics of the base cohort.** Table 1 and Table 2 report the descriptive statistics of the teachers in the base cohort.

7 Since the datasets included teachers' personal information, in order to receive the datasets, the research team had to receive Institutional Review Board (IRB) approval from PDE as well as sign a data use agreement and a data access agreement with them. After receiving the datasets, the research team was required to keep the datasets on the University of Pennsylvania's secure server at all times.

8 Although datasets for the 2010-2011 academic year were also available, they were not included in the analysis, because these data had been collected in January, while the data for the other years had been collected in June.

**TABLE 1. Characteristics of Teachers in the Base Cohort – Categorical Variables (N = 3,947).**

| VARIABLE | % | FREQUENCY |
|---|---|---|
| **Gender** | | |
| Male | 30 | 1,170 |
| Female | 70 | 2,777 |
| **Race/Ethnicity** | | |
| White | 89 | 3,530 |
| Black | 7 | 264 |
| Hispanic | 2 | 66 |
| Asian | 1 | 53 |
| Other (Native Hawaiian or Pacific Islanders, American Indian, and Multi-Racial) | 1 | 34 |
| **Age (when hired)** | | |
| Age < 30 | 50 | 1,973 |
| 30 ≤ Age < 40 | 25 | 979 |
| 40 ≤ Age < 50 | 14 | 544 |
| 50 ≤ Age | 11 | 451 |
| **Years of work experience (when hired)** | | |
| Experience < 3 | 57 | 2,232 |
| 3 ≤ Experience < 25 | 39 | 1,551 |
| 25 ≤ Experience | 4 | 164 |
| **Highest education level (at the end of the 2011-2012 academic year)** | | |
| Below BA degree | 2 | 75 |
| BA degree | 58 | 2,289 |
| MA degree | 40 | 1,563 |
| Doctoral / Specialist Degree[a] | 1 | 20 |

[a] An educational specialist degree (e.g., Ed.S.) is a terminal professional degree for individuals who have already completed a master's degree in education.

**TABLE 2. Characteristics of Teachers in the Base Cohort – Continuous Variables**

| VARIABLE | MEAN | SD | N |
|---|---|---|---|
| **Annual salary (before deductions, in the 2011-2012 academic year)** | 52,164 | 16,569 | 3,936 |
| **Hours of professional development (in the 2011-2012 academic year)[a]** | 39 | 26 | 3,101 |

[a] Only ACT 48 professional development courses were included.

## *School-level data*

**Data source.** School-level data were obtained from two publicly available datasets. Information on students' academic achievement was obtained from datasets maintained by PDE which were available from the 2014-2015 academic year to the 2017-2018 academic year. Other school-level information was obtained from the Common Core of Data (CCD) database maintained by the National Center for Education Statistics (NCES) which were available from the 2011-2012 academic year to the 2016-2017 academic year. In both datasets, each school had a unique school number and a Local Education Agency (LEA) number, making it possible to link data across the different datasets as well as with the teachers' datasets.

**Explanatory variables.** Table 3 and Table 4 present the characteristics of the schools in which the base cohort teachers taught.

**TABLE 3. Characteristics of Schools in which the Base Cohort Teachers Taught – Categorical Variables (N = 1,048).**

| VARIABLE | % | FREQUENCY |
|---|---|---|
| **Urbanicity** | | |
| Rural | 24 | 247 |
| Town | 12 | 127 |
| Suburb | 47 | 491 |
| City | 17 | 181 |
| **School size**[a] | | |
| Less than 1,000 students | 82 | 864 |
| 1,000 or more students | 18 | 184 |
| **Title 1 eligibility**[b] | | |
| Eligible | 70 | 702 |
| Not eligible | 30 | 308 |
| **School type** | | |
| Traditional public school | 86 | 906 |
| Public charter school | 14 | 142 |
| **School level** | | |
| Primary school (pre K to grade 8) | 44 | 460 |
| Middle school (grades 4 to 9) | 17 | 174 |
| High school (grades 7 to 12) | 34 | 352 |
| Other (other configurations not falling into the categories above) | 6 | 62 |

Note: Unless otherwise noted, information is from the 2011-2012 academic year.

[a] School size was calculated by averaging number of students enrolled from the 2011-2012 academic year to the 2016-2017 academic year.

[b] Information on Title 1 eligibility was available for only 1,010 schools (out of the 1,048 schools in which the base cohort teachers taught).

**TABLE 4. Characteristics of Schools in which the Base Cohort Teachers Taught – Continuous Variables.**

| VARIABLE | MEAN | SD | N |
|---|---|---|---|
| **Race/Ethnicity** | | | |
| % of White students | 68 | 32 | 1,011 |
| % of Black students | 16 | 27 | 1,011 |
| % of Hispanic students | 9 | 16 | 1,011 |
| % of other race/ethnicity students[a] | 6 | 6 | 1,011 |
| **Student-teacher ratio** | 15 | 3 | 1,011 |
| **% of male students** | 51 | 4 | 1,011 |
| **% of students below basic level for PSSA[b]** | 17 | 14 | 694 |
| **% of students below basic level for Keystone[c]** | 12 | 12 | 366 |

Note: Unless otherwise noted, school characteristics were calculated by averaging information from the 2011-2012 academic year to the 2016-2017 academic year.

[a] This category includes Asian, Native Hawaiian or Pacific Islanders, American Indian, and Multi-racial students.

[b] Schools with grades 3 to 8 had data on the PSSA assessment. Results were obtained from the 2014-2015 academic year to the 2017-2018 academic year.

[c] Schools with grade 11 had data on the Keystone assessment. Results were obtained from the 2014-2015 academic year to the 2017-2018 academic year.

# Method

## *Calculating the Survival Times*

In order to conduct the survival analysis, it was necessary to calculate the survival time for each teacher in the base cohort. The survival time was defined as the number of days during which a teacher taught full-time in the school where he or she was first hired. This was calculated by counting the number of days between the date on which the teacher started to teach full-time in one school (i.e., start date) and the date on which he or she ceased to teach full-time in that school (i.e., end date).

**Start date.** The date on which a teacher was hired by a K-12 public school in Pennsylvania was considered to be the date on which the teacher started to teach full-time in one school (i.e., start date). Due to the way in which the base cohort was defined, the start date for all teachers in the base cohort fell during the 2011-2012 academic year (i.e., between July 1, 2011 and June 30, 2012).

**End date.** Identifying the date on which a teacher ceased to teach full-time in the school where he or she was first hired (i.e., end date) was more complicated, as explained below.

Teacher's contract was terminated. If a teacher's contract with the district was terminated, the date on which this occurred (based on information in the PIMS Staff dataset) was considered to be the end date.

Summed PTA for a teacher's teaching assignments fell below 100. Even if a teacher's contract had not been terminated, if the summed PTA for a teacher's teaching assignments in the school where he or she was first hired fell below 100, the date on which this occurred (based on information in the PIMS Assignment dataset) was considered to be the end date.

**Teacher's record disappeared from the dataset.** Even if a teacher did not fall into the two categories above, if a teacher's records disappeared from the dataset, it was assumed that he or she remained a full-time teacher until June 30 of the previous academic year (the date on which the datasets were updated), and this date was considered to be the end date.

**Survival time.** As mentioned above, the number of days between the start date and the end date (i.e., the number of days during which a teacher taught full-time in the school where he or she was first hired) was taken as the teacher's survival time. On June 30, 2018 (i.e., the date on which the datasets were last updated), if a teacher was still teaching full-time at the school where he or she was first hired, the teacher's survival time was indicated as being right-censored (i.e., the exact value is unknown, but it is greater than the recorded value).

### *Cox Proportional Hazards Models*

Cox proportional hazards models were used to identify factors associated with the risk of a teacher ceasing to teach full-time in the school where he or she was first hired (i.e., the "event"). These models take into account the survival times that are right-censored, and they also assume that all groups defined by the covariates have the same underlying hazard function and that the hazard functions are proportional to one other. The Efron method was used to deal with tied events (i.e., when more than one event happened at the same time).

In the final model, 11 variables were included the Cox proportional hazards model, including six teacher-level variables (gender, race/ethnicity, years of work experience, highest educational level, annual salary, and cumulative hours of professional development) and five school-level variables (urbanicity, school size, Title 1 eligibility, school type, and percent of minority students).

## Results

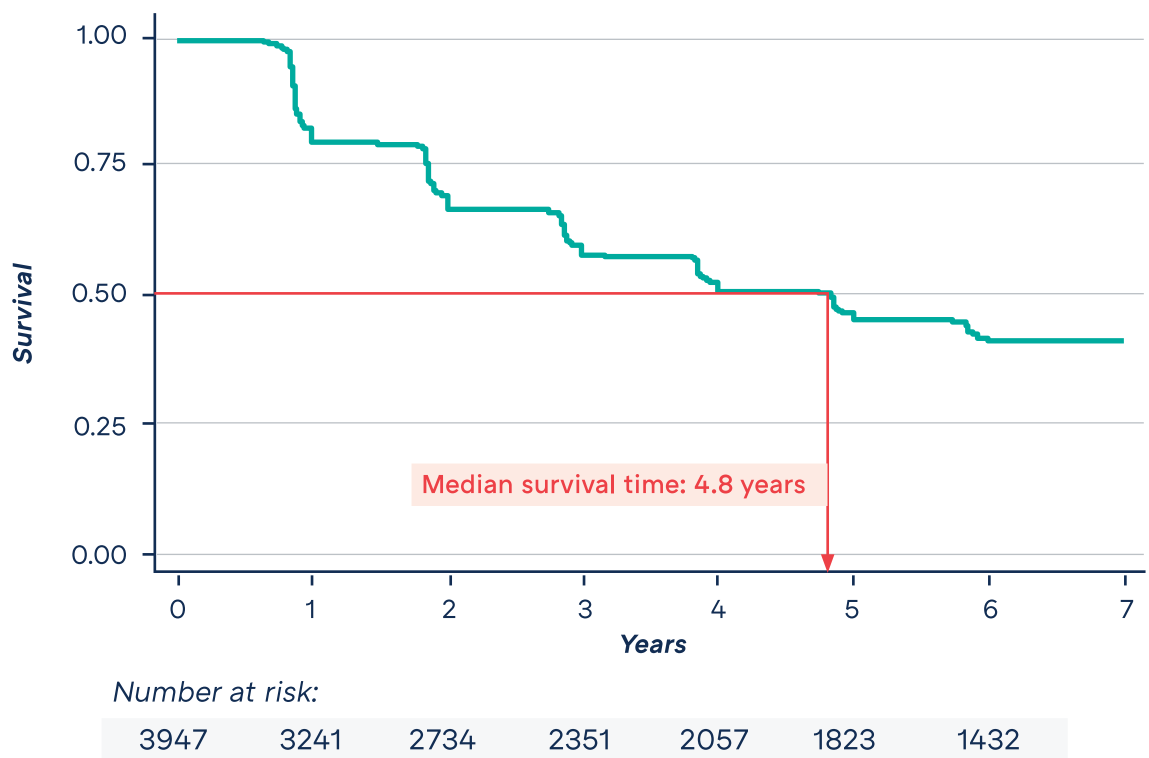
### *Survival Times*

Figure 1 presents the survival curve of the entire base cohort. The zero on the x-axis represents the day on which a teacher was hired, and the one on the axis represents one year since the teacher was hired. At each point in time on the x-axis, the value on the y-axis indicates the percentage of teachers that were still teaching full-time at the school where they were first hired (out of the 3,947 teachers included in the base cohort). On the bottom of the figure, "the number at risk" is the number used to estimate the survival probability and may not be equal to the number of remaining teachers. It is interesting to note that most of the attrition occurred at the end of each academic year, but since the start date and end date can be different across teachers, attrition is staggered across several months.

The median survival time was 4.8 years, which means that half of the teachers in the base cohort had survival times longer than 4.8 years, while the other half had survival times shorter than 4.8 years. It also means that after 4.8 years since the date of employment, only half of the teachers in the base cohort were still teaching full-time in the school where they were first hired. By the end of the seven years included in the study, only 41% of the teachers in the base cohort were still teaching full-time in the school where they were first hired.

By the **end of the seven years** included in the study, **only 41% of the teachers in the base cohort were still teaching full-time** in the school where they were first hired.

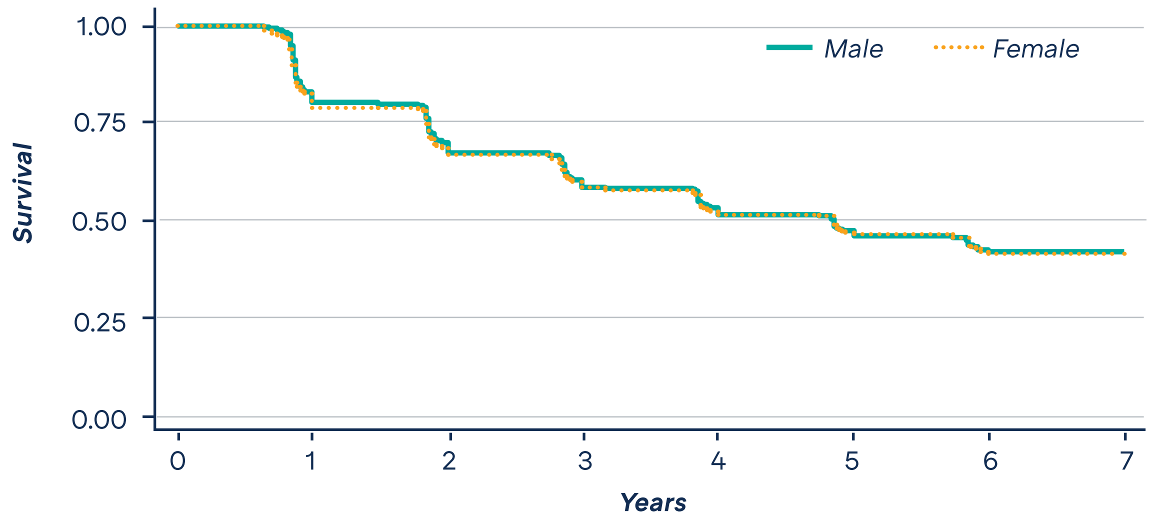
**FIGURE 1. Survival curve of the entire base cohort. N = 3,947.**




Figures 2 to 9 present the survival curves of the base cohort disaggregated by different variables. Each sub-group starts at one on the y-axis (representing 100% of the sub-group), and at each point in time on the x-axis, the value on the y-axis indicates the percentage of teachers in the sub-group that were still teaching full-time at the school where they were first hired. If the sub-group is large, the attrition of one teacher will not cause a large drop in the survival curve, producing smooth drops in the survival curve (as in Figure 1). However, if the sub-group is small, the attrition of one teacher may cause a sharp drop in the survival curve (as can be seen for the Doctoral/Specialist group in Figure 6).

It is important to note that even if there is a large difference in the survival curves of different sub-groups, it does not imply that the variable by which the teachers had been disaggregated caused a difference in the survival times (i.e., association does not imply causation). In some cases, such as the school's eligibility for Title 1 status and school type, the differences in the survival times between the sub-groups became insignificant when other variables were controlled for in the Cox proportional hazards models.

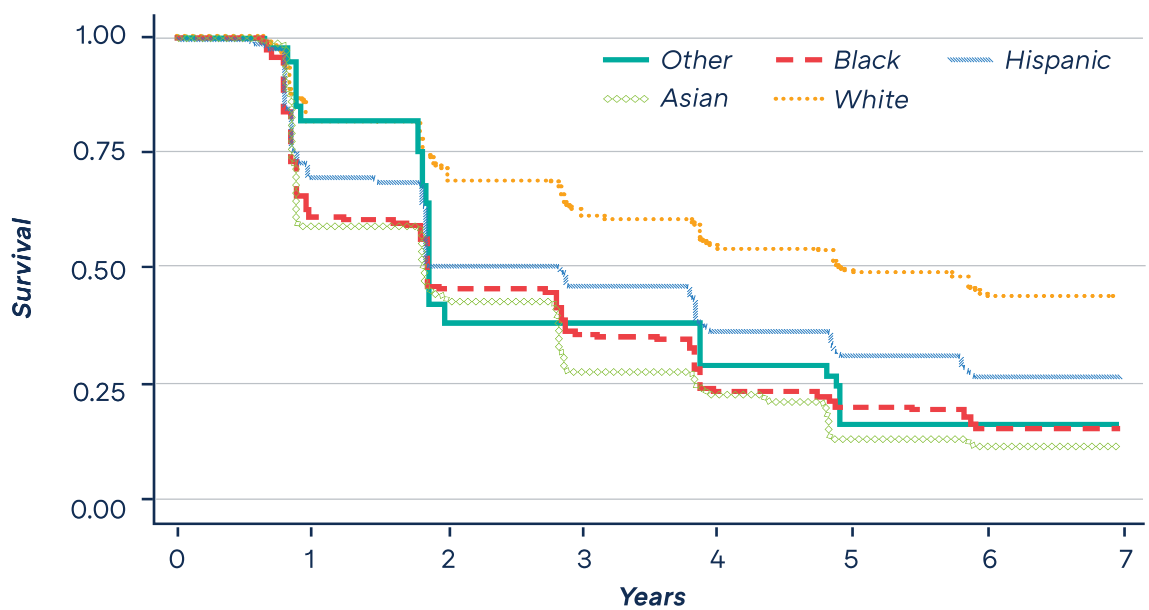
**FIGURE 2. Survival curves disaggregated by teachers' gender. N = 3,947.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Female | 2777 | 2289 | 1929 | 1661 | 1447 | 1278 | 1015 |
| Male | 1170 | 952 | 805 | 690 | 610 | 549 | 417 |

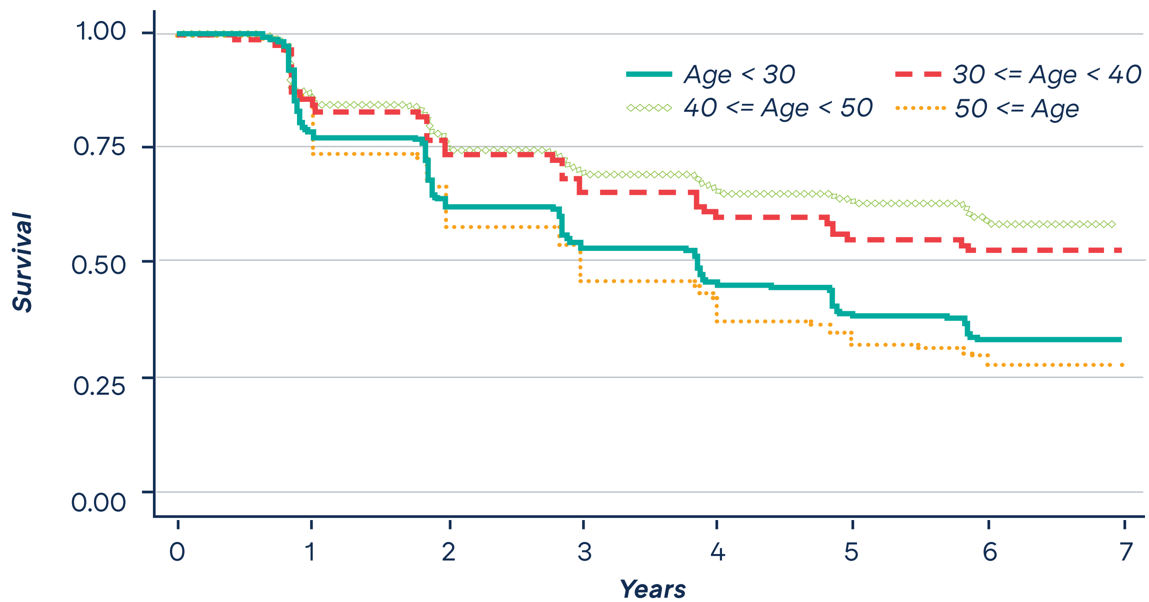
**FIGURE 3. Survival curves disaggregated teachers' race/ethnicity. N = 3,947.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Other | 34 | 24 | 12 | 11 | 13 | 7 | 6 |
| Black | 264 | 168 | 127 | 97 | 66 | 52 | 35 |
| Hispanic | 66 | 48 | 34 | 32 | 25 | 21 | 16 |
| Asian | 53 | 31 | 24 | 15 | 12 | 7 | 6 |
| White | 3530 | 2970 | 2537 | 2196 | 1941 | 1736 | 1369 |

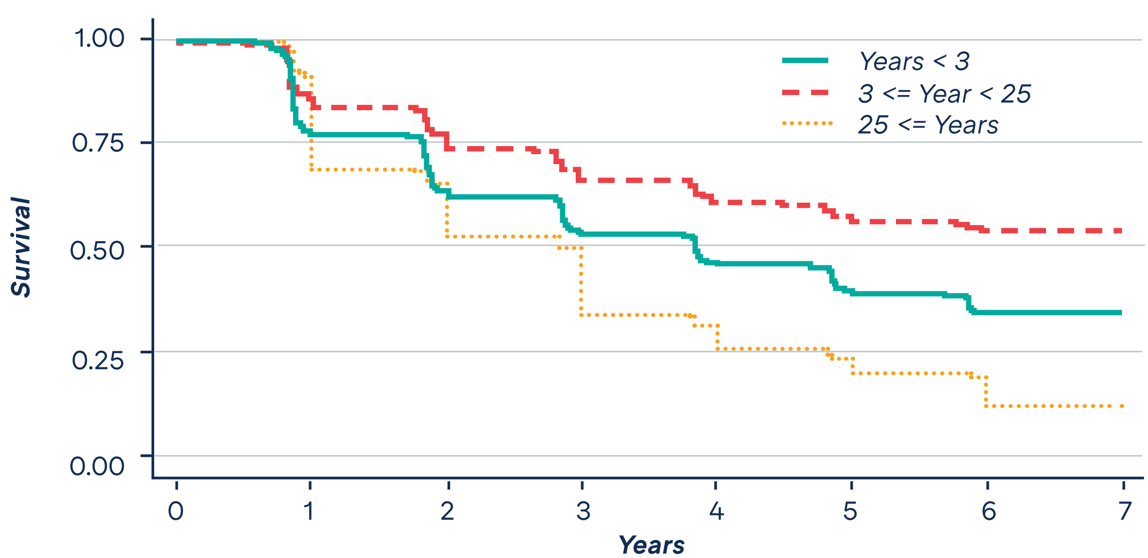
**FIGURE 4. Survival curves disaggregated by teachers' age (when hired). N = 3,947.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Age < 30 | 1973 | 1552 | 1260 | 1069 | 907 | 770 | 621 |
| 30 <= Age < 40 | 979 | 833 | 748 | 656 | 595 | 548 | 441 |
| 40 <= Age < 50 | 544 | 473 | 426 | 385 | 363 | 346 | 261 |
| 50 <= Age | 451 | 383 | 300 | 241 | 192 | 159 | 109 |

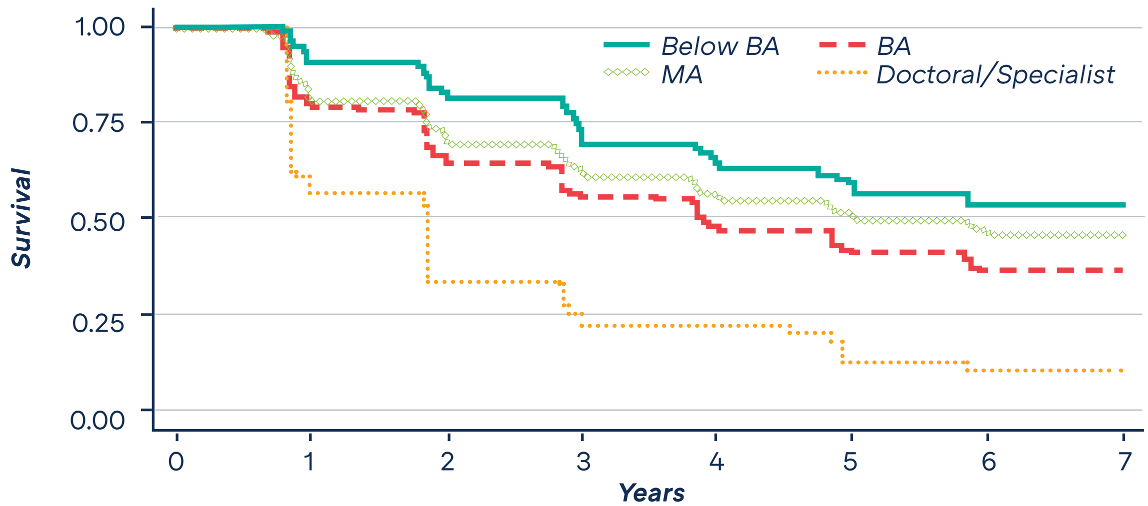
**FIGURE 5. Survival curves disaggregated by teachers' years of work experience (when hired). N = 3,947.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Years < 3 | 2232 | 1749 | 1427 | 1206 | 1040 | 892 | 683 |
| 3 <= Years < 25 | 1548 | 1326 | 1171 | 1032 | 923 | 842 | 659 |
| 25 <= Years | 164 | 150 | 108 | 81 | 52 | 39 | 31 |

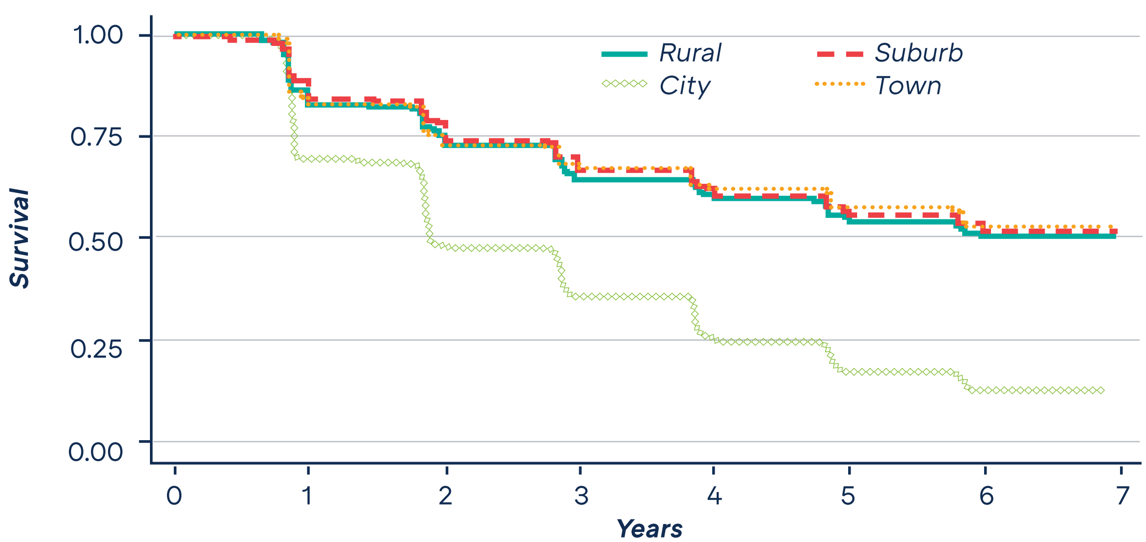
**FIGURE 6. Survival curves disaggregated by teachers' highest education level (taking into account the changes in teachers' educational attainment over time). N = 3,947.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Below BA | 75 | 67 | 64 | 56 | 47 | 43 | 39 |
| BA | 2289 | 1666 | 1286 | 1005 | 794 | 642 | 473 |
| MA | 1563 | 1490 | 1373 | 1266 | 1186 | 1128 | 912 |
| Doctoral | 20 | 17 | 10 | 10 | 10 | 5 | 5 |

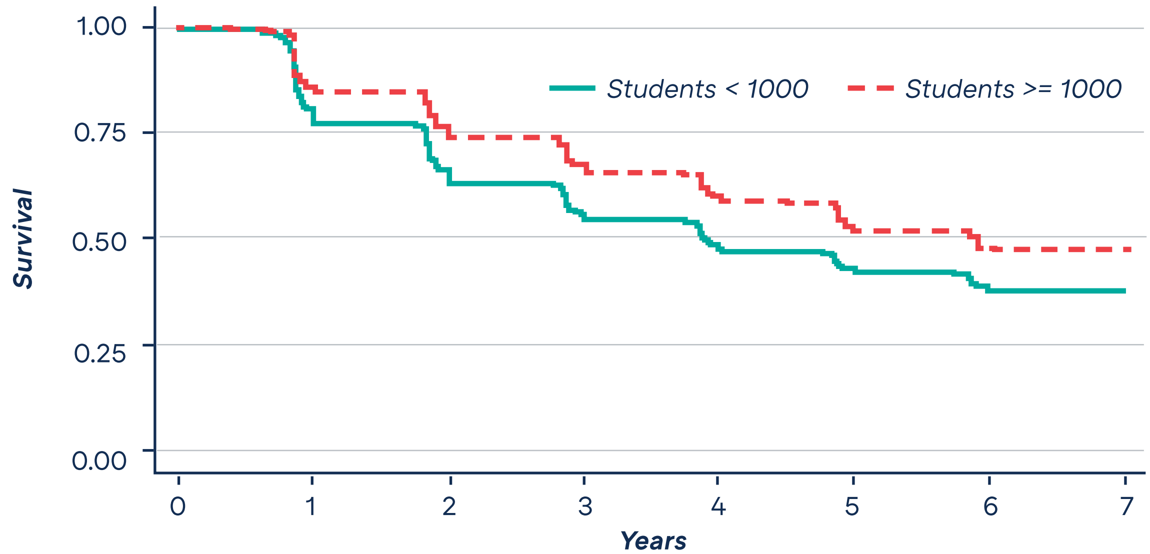
**FIGURE 7. Survival curves disaggregated by school's urbanicity (during the 2011-2012 academic year). N = 3,946.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Rural | 658 | 563 | 499 | 431 | 397 | 363 | 288 |
| Suburb | 1821 | 1603 | 1421 | 1270 | 1139 | 1043 | 799 |
| City | 1064 | 738 | 514 | 378 | 269 | 185 | 133 |
| Town | 403 | 337 | 300 | 272 | 252 | 232 | 212 |

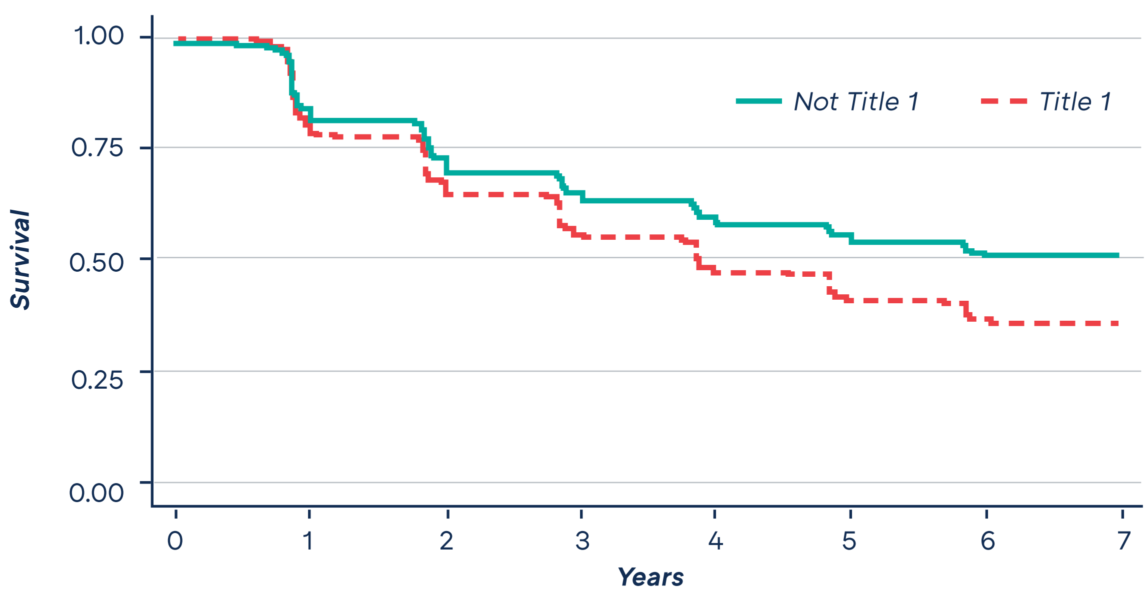
**FIGURE 8. Survival curves disaggregated by school size (averaged across the 2011-2012 academic year to the 2016-2017 academic year). N = 3,946.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Students < 1000 | 2833 | 2283 | 1888 | 1599 | 1389 | 1235 | 963 |
| Students >= 1000 | 1113 | 958 | 846 | 752 | 668 | 588 | 469 |

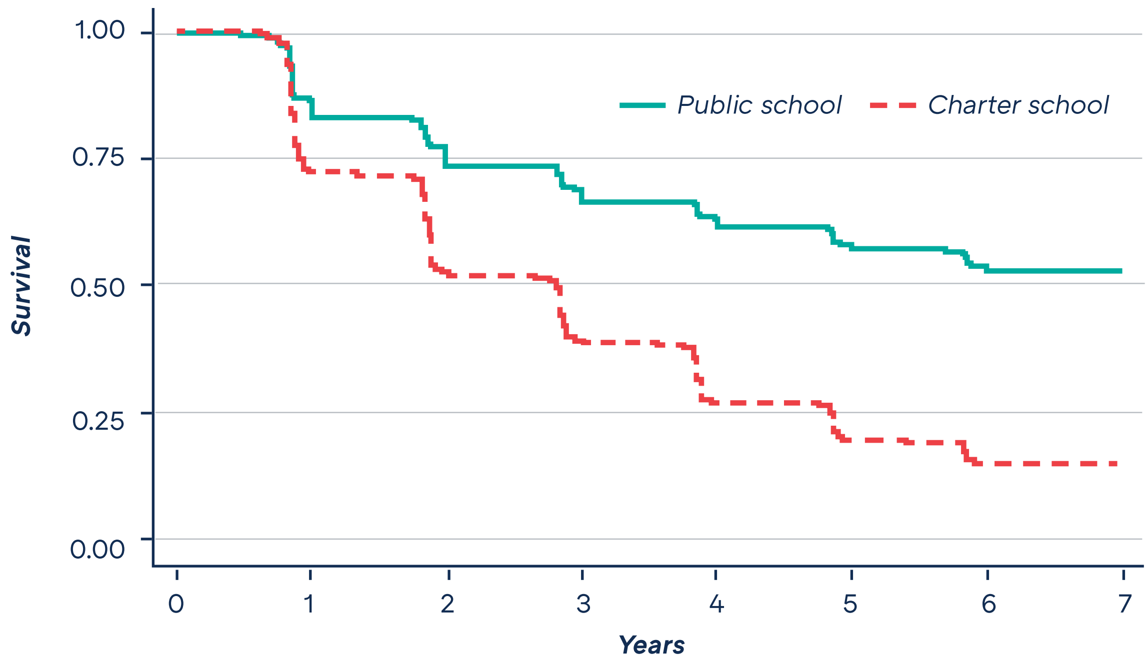
**FIGURE 9. Survival curves disaggregated by school's Title 1 eligibility (during the 2011-2012 academic year). N = 3,808.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Not Title 1 eligible | 1142 | 964 | 837 | 747 | 688 | 639 | 441 |
| Title 1 eligible | 2666 | 2159 | 1795 | 1519 | 1298 | 1118 | 933 |

**FIGURE 10. Survival curves disaggregated by school type (during the 2011-2012 academic year). N = 3,946.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Traditional public school | 2700 | 2330 | 2079 | 1860 | 1709 | 1575 | 1242 |
| Public charter school | 1246 | 911 | 655 | 491 | 348 | 248 | 190 |

## *Cox Proportional Hazards Models*

The results of the Cox proportional hazards models are presented in Table 5. Model 1 includes all teachers (i.e., the pooled base cohort), while Models 2 to 4 disaggregate teachers by their age when they were hired – Model 2 includes teachers who were under 30 when hired (i.e., the younger group), Model 3 includes teachers who were 30 and over but under 50 when hired (i.e., the middle-aged group), and Model 4 includes teachers who were 50 and over when hired (i.e., the older group).

When the hazard ratio for a variable is less than one, it indicates that the variable is associated with a lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired (i.e., it is a protective factor), controlling for all other variables included in the model. Conversely, a hazard ratio over one indicates that the variable is associated with a higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired (i.e., it is a risk factor), controlling for all other variables included in the model. Again, it is important to note that an association does not imply causation. Also, it should be kept in mind that only 83% of the teachers in the base cohort (i.e., 3,273 teachers out of 3,947 teachers) had data on all 13 variables included in the model, so the results may be biased if data on some variables were not missing at random.

**Gender.** For the pooled base cohort and all age groups, being male neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

**Being male neither increased nor decreased the risk** of a teacher ceasing to teach full-time at the school where he or she was first hired.

**Race/Ethnicity.** For the pooled base cohort, the younger group, and the middle-aged group, being from a non-White racial/ethnic group neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the older group, being Hispanic, compared to being White, was associated with a 418% higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

**Being from a non-White racial/ethnic group neither increased nor decreased the risk** of a teacher ceasing to teach full-time at the school where he or she was first hired.

**Years of work experience (when hired).** For the pooled base cohort, each additional year of work experience was associated with a 5% higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the younger group and middle-aged group, each additional year of work experience neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the older group, each additional year of work experience was associated with a 5% higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model. This was understandable, considering that many teachers in this age group were eligible for retirement.

**Highest educational level (when the event occurred).** For the pooled base cohort, having a degree below a BA degree, compared to having a BA degree, was associated with a 73% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model. Having a Doctoral/ Specialist degree[5], compared to having a BA degree, was associated with an 86% higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the younger group, having a higher or lower educational level than a BA degree, compared to having a BA degree, neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the middle-aged group, having an MA degree, compared to having a BA degree, was associated with a 23% higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model. Having a Doctoral/Specialist degree, compared to having a BA degree, was associated with a 103% higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the older group, having a Doctoral/Specialist degree, compared to having a BA degree, was associated with a 136% higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

**Annual salary (when the event occurred).** For the pooled base cohort, a $6,000 increase in the annual salary (i.e., $500 increase in the monthly salary) was associated with a 15% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the younger group, a $6,000 increase in the annual

**Each additional year of work experience** was associated with **a 5% increase in the risk** of a teacher ceasing to teach full-time at the school where he or she was first hired.

5 An educational specialist (e.g., Ed.S.) is a terminal professional degree for individuals who have already completed a master's degree in education.

salary (i.e., $500 increase in the monthly salary) was associated with a 20% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the middle-aged group, a $6,000 increase in the annual salary (i.e., $500 increase in the monthly salary) was associated with a 13% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the older group, a $6,000 increase in the annual salary (i.e., $500 increase in the monthly salary) neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

It is interesting to note that an increase in salary was a protective factor for the younger group and the middle-aged group, but the magnitude of the "protection" decreased with age. For the older group, it was no longer a protective factor. It should also be noted that while salary was not lagged in the model (i.e., the model took into account a teacher's salary when the event occurred, not the teacher's salary from the previous year), it was lagged in practical terms, since a teacher knew his or her monthly salary before making the decision to stop teaching full-time at the school where he or she was first hired. In other words, in terms of the sequence of events, the teacher's salary was known before the event occurred.

**An increase in salary was a protective factor** for the younger group and the middle-aged group, but the magnitude of the "protection" decreased with age.

**Cumulative hours of professional development (when the event occurred, including only ACT 48 professional development courses).** For the pooled base cohort, a 10 hour increase in the cumulative hours of professional development was associated with a 3% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the younger group, a 10 hour increase in the cumulative hours of professional development was associated with a 2% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the middle-aged group, a 10 hour increase in the cumulative hours of professional development was associated with a 3% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

**An increase in the cumulative hours of professional development was a protective factor** for all age groups, and the magnitude of the "protection" increased with age.

For the older group, a 10 hour increase in the cumulative hours of professional development was associated with a 9% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

It is interesting to note that an increase in the cumulative hours of professional development was a protective factor for all age groups, and that the magnitude of the "protection" increased with age.

**Teaching in a city** (versus in a rural area) was associated with **a 30% increase in the risk** of a teacher ceasing to teach fulltime at the school where he or she was first hired.

**Urbanicity (during the 2011-2012 academic year).** For the pooled base cohort, teaching in a city, compared to teaching in a rural area, was associated with a 30% higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

When the teachers were divided into age group, the urbanicity of the school neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, compared to teaching in a rural school, controlling for all other variables in the model.

Teaching in **a school with 1,000 or more students** was associated with **a 27% decrease in the risk** of a teacher ceasing to teach full-time at the school where he or she was first hired.

**School size (averaged across the 2011-2012 academic year to the 2016-2017 academic year).** For the pooled base cohort, teaching in a school with 1,000 or more students, compared to teaching in a school with under 1,000 students, was associated with a 27% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the younger group, teaching in a school with 1,000 or more students, compared to teaching in a school with under 1,000 students, was associated with a 22% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the middle-aged group, teaching in a school with 1,000 or more students, compared to teaching in a school with under 1,000 students, was associated with a 29% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the older group, teaching in a school with 1,000 or more students, compared to teaching in a school with under 1,000 students, was associated with a 42% lower risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

It is interesting to note that teaching in a school with 1,000 or more students was a protective factor for all age groups, and that the magnitude of the "protection" increased with age.

Teaching in a school eligible for **Title 1 status neither increased nor decreased the risk** of a teacher ceasing to teach full-time at the school where he or she was first hired.

**Title 1 eligibility (during the 2011-2012 academic year).** For the pooled base cohort and all age groups, teaching in a school eligible for Title 1 status, compared to teaching in a school not eligible for Title 1 status, neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

**School type (during the 2011-2012 academic year).** For the pooled base cohort and all age groups, teaching in a public charter school, compared to teaching in a traditional public school, neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

Teaching in a **public charter school neither increased nor decreased** the risk of a teacher ceasing to teach full-time at the school where he or she was first hired.

**Percent of racial/ethnic minority students (averaged across the 2011-2012 academic year to the 2016-2017 academic year).** For the pooled base cohort, the younger group, and the middle-aged group, a one percentage point increase in the percent of minority students in school was associated with a 1% higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

For the older group, a one percentage point increase in the percent of minority students in school neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

A one percentage point increase in the **percent of minority students in a school** was associated with **a 1% increase in the risk** of a teacher ceasing to teach full-time at the school where he or she was first hired.

**TABLE 5. Cox Proportional Hazards Models (Hazard Ratios)**

| VARIABLE | MODEL 1: All teachers (*N* = 3,273) | MODEL 2: Age < 30 (*N* = 1,640) | MODEL 3: 30 ≤ Age < 50 (*N* = 1,294) | MODEL 4 50 ≤ Age (*N* = 352) |
|---|---|---|---|---|
| **Individual-level variables** | | | | |
| Gender (Reference: Female) | | | | |
| Male | 1.002 | 1.098 | 1.04 | 0.939 |
| Race/Ethnicity (Reference: White) | | | | |
| Black | 1.01 | 1.105 | 0.96 | 1.278 |
| Hispanic[a] | 0.712 | 0.739 | 0.646 | 5.180** |
| Asian[a] | 1.326 | 1.256 | 1.676 | 0.622 |
| Other[a] | 1.055 | 1.149 | 0.799 | 0.581 |
| Years of work experience[b] | 1.051*** | 1.041 | 1.002 | 1.051*** |
| Highest educational level (Reference: BA)[c] | | | | |
| Below BA[a] | 0.265* | 0.000 | 0.000 | 1.088 |
| MA | 1.051 | 1.069 | 1.228* | 1.13 |
| Doctoral / Specialist[a,d] | 1.862** | 1.633 | 2.031* | 2.364* |
| Annual salary[e] | 0.848*** | 0.803*** | 0.867*** | 0.953 |
| Cumulative hours of professional development[f] | 0.972*** | 0.982*** | 0.967*** | 0.905*** |
| | | | | |
| **School-level variables** | | | | |
| Urbanicity (Reference: Rural)[g] | | | | |
| Town | 1.07 | 1.147 | 1.142 | 1.049 |
| Suburb | 1.152 | 1.161 | 1.029 | 1.179 |
| City | 1.295* | 1.296 | 1.179 | 1.259 |
| School size (Reference: Under 1,000 students)[h] | | | | |
| 1,000 or more students | 0.730*** | 0.776*** | 0.706** | 0.578*** |
| Title 1 eligibility (Reference: Not eligible)[g] | | | | |
| Eligible | 0.971 | 0.95 | 0.972 | 0.984 |
| School type (Reference: traditional public school)[g] | | | | |
| Public charter school | 1.07 | 1.009 | 1.095 | 1.823 |
| % of minority students[h] | 1.010*** | 1.010*** | 1.011*** | 1.008 |

Note: Teachers' age (when hired) were used to divide them into age groups for Models 2 to 4.

[a] These groups have a small sample size (<70).

[b] Years of work experience when hired.

[c] Highest educational degree when the event occurred.

[d] An educational specialist degree (e.g., Ed.S.) is a terminal professional degree for individuals who have already completed a master's degree in education.

[e] Salary (before deductions) when the event occurred, in units of $6,000 annually (or $500 monthly).

[f] Cumulative hours of professional development when the event occurred, in units of 10 hours. Only ACT 48 professional development courses were included in the analysis.

[g] During the 2011-2012 academic year.

[h] Calculated by averaging information from the 2011-2012 academic year to the 2016-2017 academic year.

*p<.05 **p<.01 ***p<.001

# Summary and Discussion

This study aimed to calculate the median length of time a newly hired teacher in Pennsylvania taught full-time in the school where he or she was hired, as well as the relationship between teacher attrition and other factors. Administrative records on all teachers in Pennsylvania were used to identify a base cohort of teachers who were newly hired in a K-12 public school (including charter schools) in the 2011-2012 academic year and taught full-time in one school. Each member of the base cohort was observed from this origin time until a specific event occurred, defined as a teacher ceasing to teach full-time at the school where he or she was first hired. The events counted teachers who left the teaching profession altogether; teachers who moved to another state, district, or school; and teachers who continued to work at their original school of employment, but with a reduced teaching load. Note that this specific definition of an event informed the results of the analysis. In other words, a different definition of an event may have led to different results, such as less dramatic rates of attrition.

Among the 3,947 teachers in the base cohort, **the median survival time was 4.8 years.** This means that after 4.8 years since the date of employment, approximately 50% of the teachers in the base cohort no longer taught full-time at the school where he or she was first hired.

With respect to the first research question, the analysis found that among the 3,947 teachers in the base cohort, the median survival time was 4.8 years. This means that after 4.8 years since the date of employment, approximately 50% of the teachers in the base cohort no longer taught full-time at the school where he or she was first hired. This is generally consistent with previous studies which estimated that at the national level, 30% to 50% of newly hired teachers left their school or profession within five years of hire (Gray & Taie, 2015; Ingersoll, 2001). At the end of the seven years included in the study, 41% of the teachers in the base cohort were still teaching full-time in the school where they were first hired.

With respect to the second research question, this study explored the relationship of several factors to teacher attrition: teachers' gender, race/ethnicity, years of work experience (when hired), highest education level, annual salary, and cumulative hours of professional development, as well as schools' urbanicity, size, Title I eligibility, charter school status, and proportion of students in a minority race/ethnicity category. Cox proportional hazard models were used to generate a hazard ratio for each factor, indicating whether it was a protective factor or a risk factor for attrition among teachers.

The models indicated that for all three age groups included in the analysis (i.e., younger teachers under age 30, middle-aged teachers age 30 to age 50, and older teachers age 50 and above at the time of hire), the teacher's gender and race/ethnicity (with one exception, noted below), neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model. At the school level, schools' urbanicity, Title I eligibility and charter school status also neither increased nor decreased the risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model. The exception was that, among older teachers, being Hispanic compared to being White was associated with a higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

The analysis also revealed several protective factors that decreased the risk of a teacher ceasing to teach full-time in the school where he or she was first hired. The most notable was annual salary (whose magnitude as a protective factor decreased with age, controlling for all other variables in the model) and cumulative hours of professional development (whose magnitude as a protective factor increased with age, controlling for all other variables in the model). For all three age groups included in the analysis, teaching in a larger school in Pennsylvania (with 1,000 or more students) was also associated with a decreased risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model. This is consistent with some research which suggested that attrition rates were higher in elementary schools than in secondary schools (Borman & Dowling, 2008), but further research is warranted to fully understand this finding.

The analysis also revealed **several protective factors** that decreased the risk of a teacher ceasing to teach full-time in the school where he or she was first hired. The most notable was **annual salary** (whose magnitude as a protective factor decreased with age) and cumulative **hours of professional development** (whose magnitude as a protective factor increased with age). For all three age groups included in the analysis, teaching in a **larger school** in Pennsylvania (with 1,000 or more students) was also associated with a decreased risk of a teacher ceasing to teach full-time at the school where he or she was first hired.

The analysis also revealed several risk factors associated with an increased risk of a teacher ceasing to teach full-time at the school where he or she was first hired. For younger teachers, an increase in the percent of minority students in school was associated with a higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model. For the middle-aged teachers, having an MA or a doctoral/specialist degree (compared to having a BA degree), and an increase in the percent of minority students in school was associated with a higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model. For the older teachers, an increase in the years of work experience and having a doctoral/specialist degree (compared to having a BA degree) was associated with a higher risk of a teacher ceasing to teach full-time at the school where he or she was first hired, controlling for all other variables in the model.

## *Limitations*

As with any model-based research, the results of the Cox proportional hazards models may not accurately reflect the true association between the variables and teacher attrition if other relevant variables were not included in the model, or if the sample size for some groups included in the model were too small. Also, the results may have been influenced by the particular characteristics of teachers that were newly hired in K-12 public schools, including charter schools, in Pennsylvania during the 2011-2012 academic year. In other words, these results may not be generalizable to other populations of teachers. Therefore, the results should be interpreted in light of these limitations.

More fundamentally, an important limitation of this study is the potential for errors in the administrative records reported by individual schools. While conducting the study, the research team encountered several errors and inconsistencies in the dataset. For example, there were many teachers in the PIMS Staff dataset (which has information on teachers' contract) that were not included in the PIMS Assignment dataset (which has information on each assignment of the teacher). Also, for some teachers, the end date of the teacher's contract (in the PIMS Staff dataset) preceded the completion date of an assignment (in the PIMS Assignment dataset). For some teachers, there was no information on the end date of their contract in one year, but they disappeared from the dataset in the following year. In addition, although the PIMS manual advised schools to report the years of work experience as one for newly recruited teachers, it was reported as zero for some of these teachers. Also, while PDE advised schools to report salary as zero for teachers whose contract was terminated, this rule was not applied to some teachers. Lastly, for some teachers, information on the start date of the contract, start date of an assignment, and the teacher's birthday was not consistent across datasets from different years. Since it was not possible for PDE or the research team to correct these errors and inconsistencies, the research team made a priori rules on how to deal with each type of issue. However, this means that the results of the study may not accurately represent the true association between teacher attrition and the variables included in the models. One recommendation to increase the accuracy of future research findings is for PDE to provide stronger guidance to schools on how to accurately report data and to conduct quality checks at the state level to identify and address data entry errors or discrepancies. Accurate data will translate to more meaningful, consistent research and analysis of pressing issues such as teacher attrition.

## *Conclusion*

This study contributes to the literature examining instability in the teacher workforce by describing and analyzing factors associated with the attrition of newly hired K-12 teachers in public schools in Pennsylvania. By considering the protective factors and risk factors associated with teachers' attrition, PDE can provide better support to teachers, schools, and districts to strategically increase the retention of K-12 teachers in Pennsylvania.

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# Annex – Analysis for Principals

**TABLE 1. Characteristics of Principals in the Base Cohort – Categorical Variables (N = 278).**

| VARIABLE | % | FREQUENCY |
|---|---|---|
| **Gender** | | |
| Male | 54 | 149 |
| Female | 46 | 129 |
| **Race/Ethnicity** | | |
| White | 74 | 206 |
| Black | 21 | 59 |
| Hispanic | 2 | 6 |
| Asian | 1 | 3 |
| Multi-Racial | 1 | 4 |
| **Age (when hired)** | | |
| Age < 30 | 4 | 12 |
| 30 ≤ Age < 40 | 51 | 142 |
| 40 ≤ Age < 50 | 31 | 85 |
| 50 ≤ Age | 14 | 39 |
| **Years of work experience (when hired)** | | |
| Experience < 3 | 27 | 74 |
| 3 ≤ Experience < 25 | 66 | 184 |
| 25 ≤ Experience | 7 | 20 |
| **Highest education level (at the end of the 2011-2012 academic year)** | | |
| BA degree | 25 | 69 |
| MA degree | 71 | 197 |
| Doctoral / Specialist Degree[a] | 4 | 12 |

[a] An educational specialist degree (e.g., Ed.S.) is a terminal professional degree for individuals who have already completed a master's degree in education.

**TABLE 2. Characteristics of Principals in the Base Cohort – Continuous Variables.**

| VARIABLE | MEAN | SD | N |
|---|---|---|---|
| **Annual salary (before deductions, in the 2011-2012 academic year)** | 93,540 | 21,953 | 278 |
| **Hours of professional development (in the 2011-2012 academic year)[a]** | 30 | 20 | 239 |

[a] Only ACT 48 professional development courses were included.

**TABLE 3. Characteristics of Schools in which the Base Cohort Principals Taught – Categorical Variables (N = 229).**

| VARIABLE | % | FREQUENCY |
|---|---|---|
| **Urbanicity** | | |
| Rural | 19 | 43 |
| Town | 6 | 13 |
| Suburb | 45 | 104 |
| City | 30 | 69 |
| **School size[a]** | | |
| Less than 1,000 students | 82 | 187 |
| 1,000 or more students | 18 | 42 |
| **Title 1 eligibility[b]** | | |
| Eligible | 74 | 163 |
| Not eligible | 26 | 57 |
| **School type** | | |
| Traditional public school | 86 | 197 |
| Public charter school | 14 | 32 |
| **School level** | | |
| Primary school (pre K to grades 8) | 45 | 104 |
| Middle school (grades 4 to 9) | 16 | 37 |
| High school (grades 7 to 12) | 32 | 73 |
| Other (other configurations not falling into the categories above) | 7 | 15 |

Note: Unless otherwise noted, information is from the 2011-2012 academic year.

[a] School size was calculated by averaging number of students enrolled from the 2011-2012 academic year to the 2016-2017 academic year.

[b] Information was available for only 220 schools (out of 229 schools)

**TABLE 4. Characteristics of Schools in which the Base Cohort Teachers Taught – Continuous Variables.**

| VARIABLE | MEAN | SD | N |
|---|---|---|---|
| **Race/Ethnicity** | | | |
| % of White students | 55 | 37 | 220 |
| % of Black students | 29 | 35 | 220 |
| % of Hispanic students | 9 | 14 | 220 |
| % of other race/ethnicity students[a] | 7 | 6 | 220 |
| **Student-teacher ratio** | 15 | 3 | 220 |
| **% of male students** | 51 | 5 | 220 |
| **% of students below basic level for PSSA[b]** | 22 | 17 | 145 |
| **% of students below basic level for Keystone[c]** | 15 | 15 | 78 |

Note: Unless otherwise noted, school characteristics were calculated by averaging information from the 2011-2012 academic year to the 2016-2017 academic year.

[a] This category includes Asian, Native Hawaiian or Pacific Islander, American Indian, and Multi-Racial students.

[b] Schools with grades 3 to 8 had data on the PSSA assessment. Results were obtained from the 2014-2015 academic year to the 2017-2018 academic year.

[c] Schools with grade 11 had data on the Keystone assessment. Results were obtained from the 2014-2015 academic year to the 2017-2018 academic year.

**FIGURE 1. Survival curve of the entire base cohort. N = 278.**

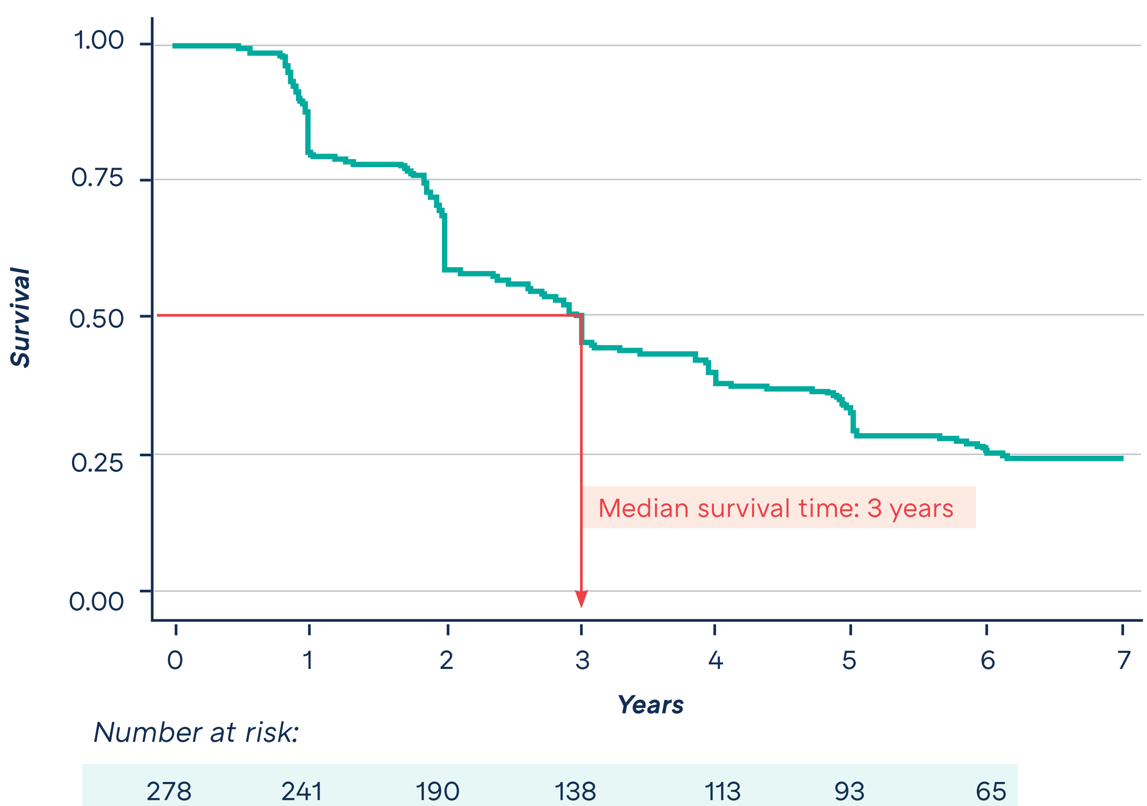
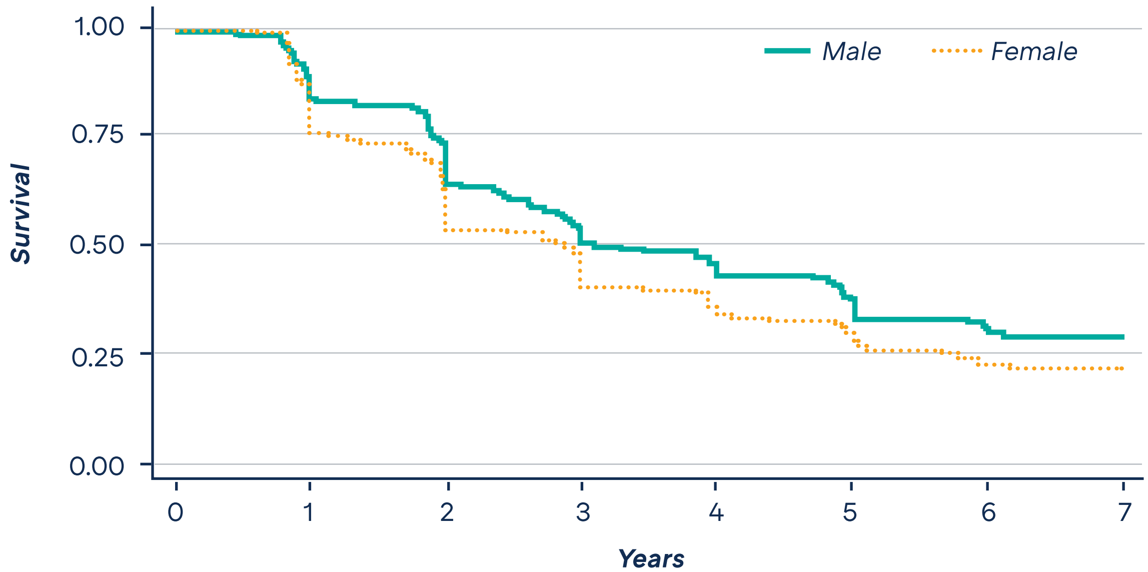


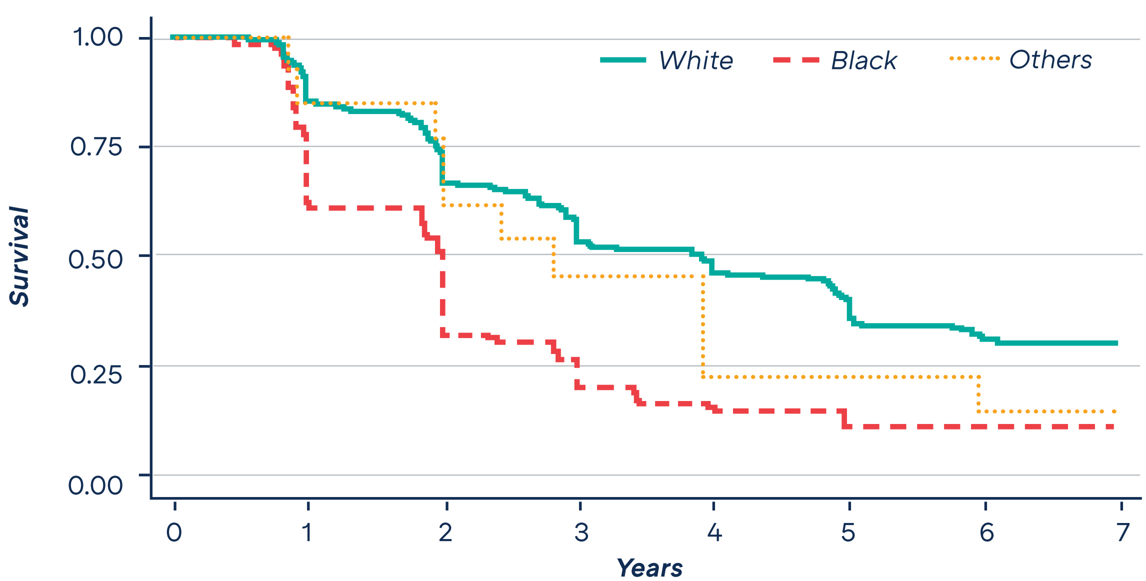
**FIGURE 2. Survival curves disaggregated by principals' gender. N = 278.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Female | 149 | 131 | 107 | 79 | 67 | 55 | 37 |
| Male | 129 | 110 | 83 | 59 | 46 | 38 | 28 |

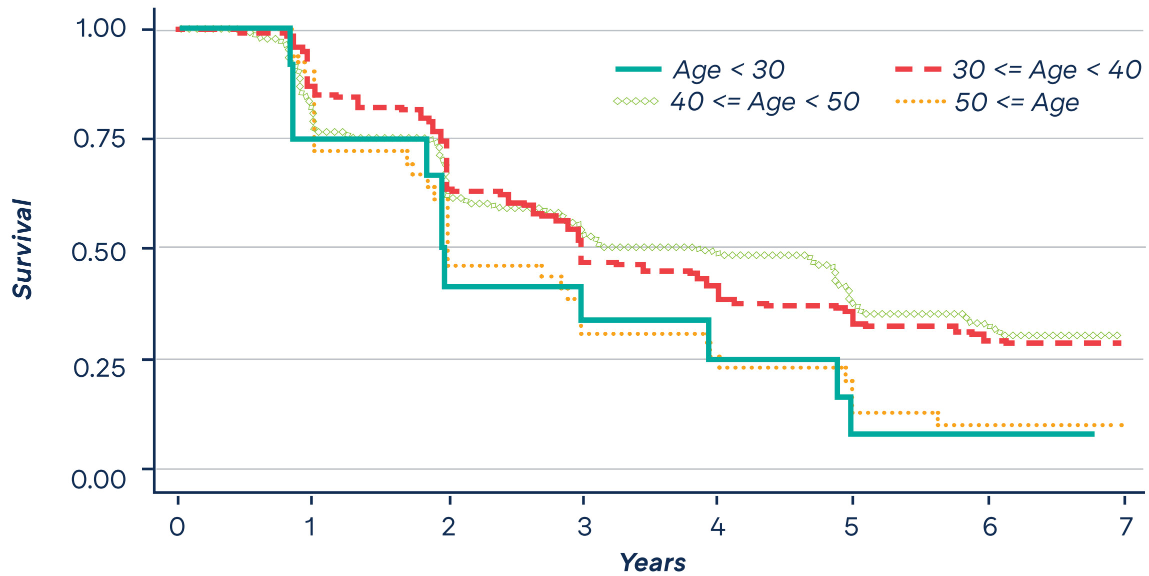
**FIGURE 3. Survival curves disaggregated principals' race/ethnicity. N = 278.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| White | 206 | 184 | 150 | 117 | 100 | 82 | 56 |
| Black | 59 | 46 | 30 | 15 | 10 | 8 | 7 |
| Other | 13 | 11 | 10 | 6 | 3 | 3 | 2 |

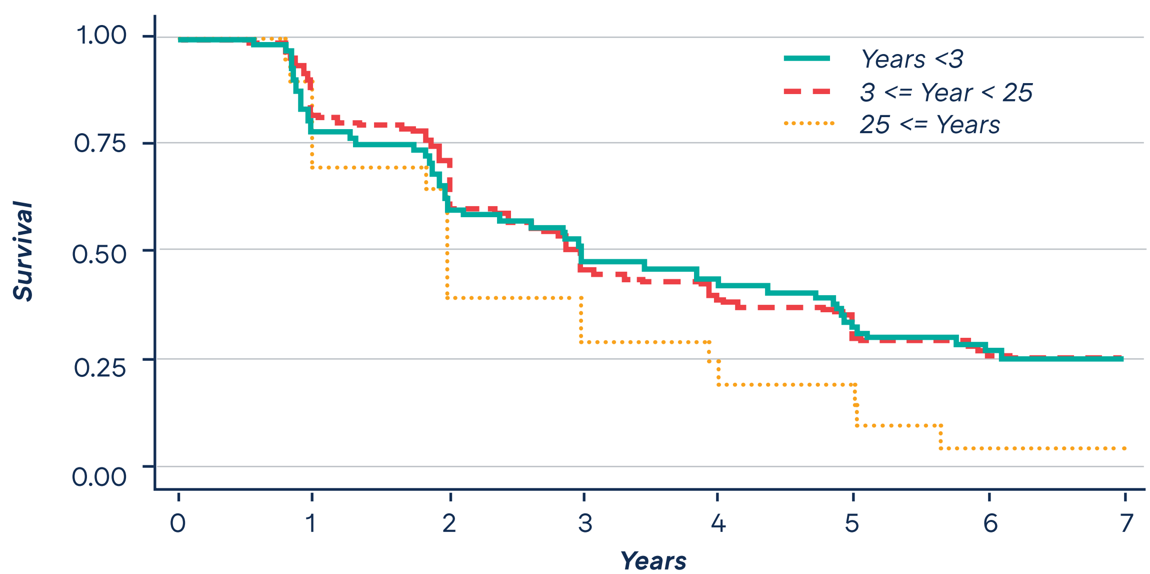
**FIGURE 4. Survival curves disaggregated by principals' age (when hired). N = 278.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Age < 30 | 12 | 9 | 6 | 4 | 3 | 1 | 1 |
| 30 <= Age < 40 | 142 | 127 | 101 | 73 | 58 | 49 | 36 |
| 40 <= Age < 50 | 85 | 70 | 59 | 47 | 42 | 35 | 25 |
| 50 <= Age | 39 | 35 | 24 | 14 | 10 | 8 | 3 |

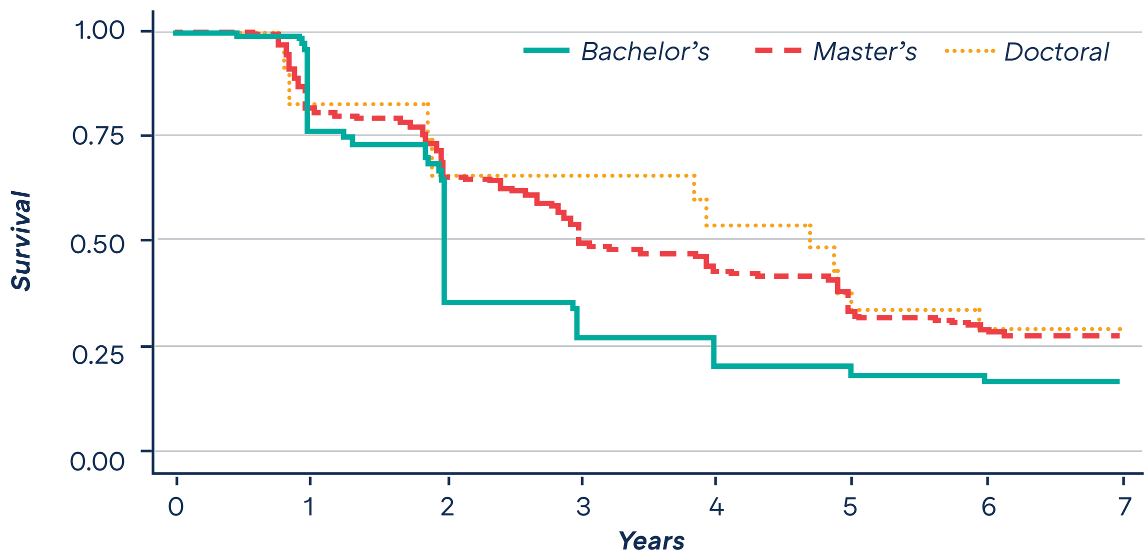
**FIGURE 5. Survival curves disaggregated by principals' years of work experience (when hired). N = 277.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Years < 3 | 74 | 59 | 46 | 37 | 32 | 24 | 18 |
| 3 <= Years < 25 | 183 | 161 | 127 | 88 | 70 | 59 | 36 |
| 25 <= Years | 20 | 18 | 13 | 8 | 5 | 4 | 1 |

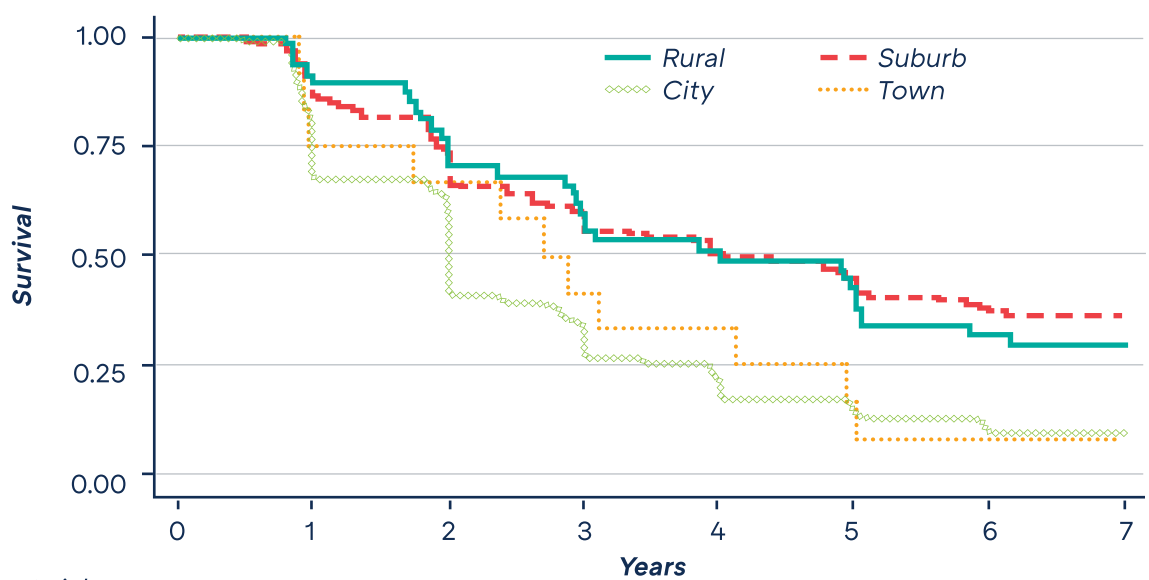
**FIGURE 6. Survival curves disaggregated by principals' highest education level (taking into account the changes in principals' educational attainment across time). N = 278.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BA | 69 | 60 | 38 | 20 | 16 | 12 | 9 |
| MA | 197 | 171 | 143 | 107 | 88 | 72 | 48 |
| Doctoral | 12 | 10 | 9 | 11 | 9 | 9 | 8 |

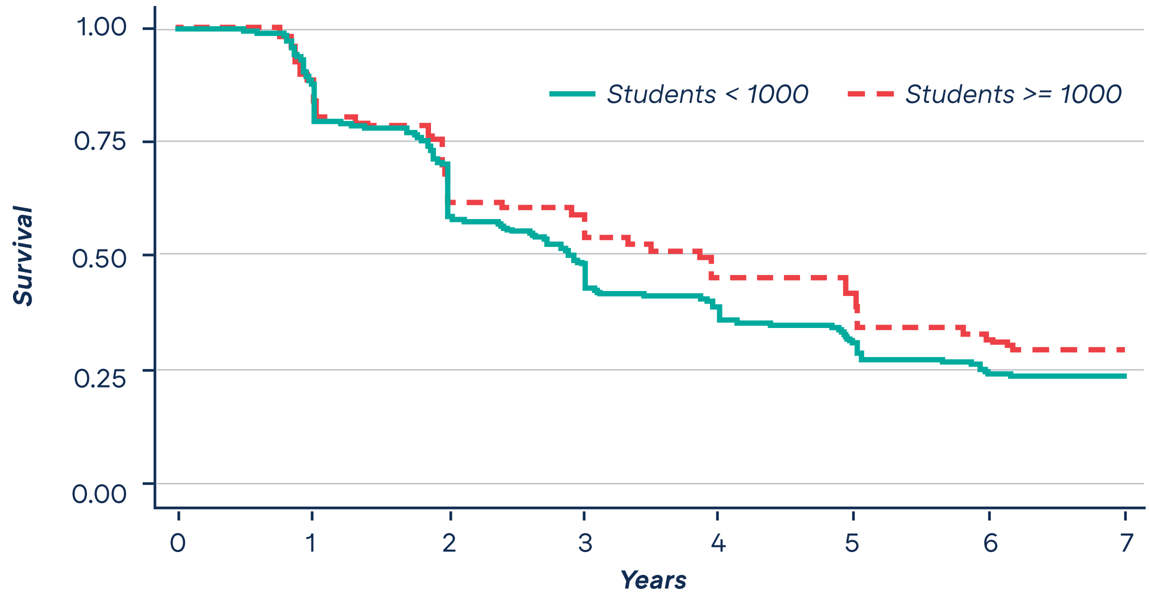
**FIGURE 7. Survival curves disaggregated by school's urbanicity (during the 2011-2012 academic year). N = 278.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Rural | 47 | 43 | 36 | 28 | 24 | 20 | 13 |
| Suburb | 132 | 120 | 94 | 77 | 66 | 59 | 42 |
| City | 86 | 69 | 52 | 28 | 19 | 12 | 9 |
| Town | 13 | 9 | 8 | 5 | 4 | 2 | 1 |

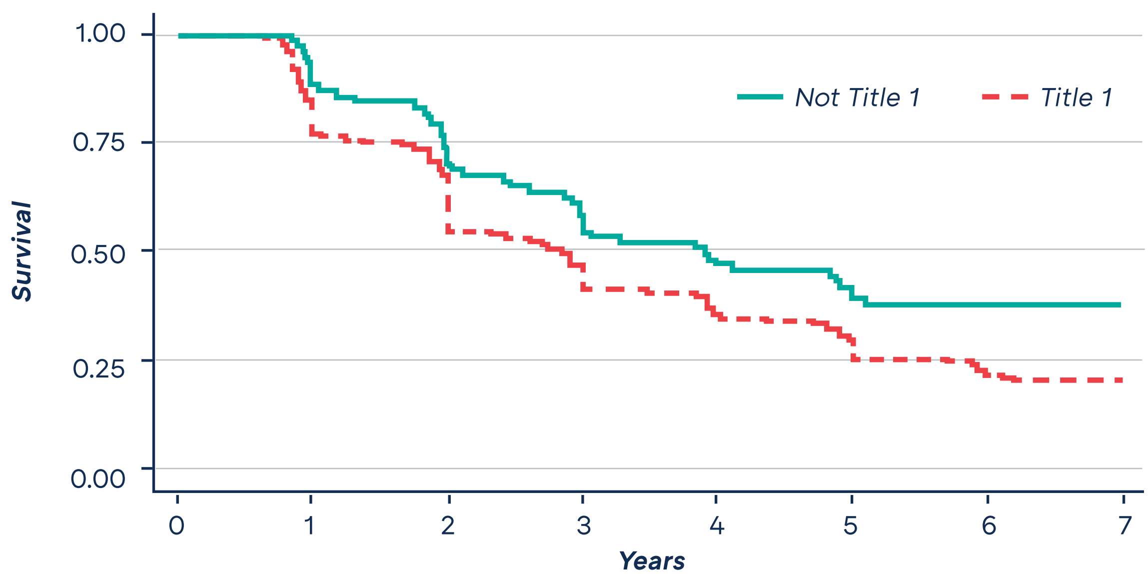
**FIGURE 8. Survival curves disaggregated by school size (averaged across the 2011-2012 academic year to the 2016-2017 academic year). N = 278.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Students < 1000 | 212 | 183 | 146 | 100 | 83 | 67 | 45 |
| Students >= 1000 | 66 | 58 | 44 | 38 | 30 | 26 | 20 |

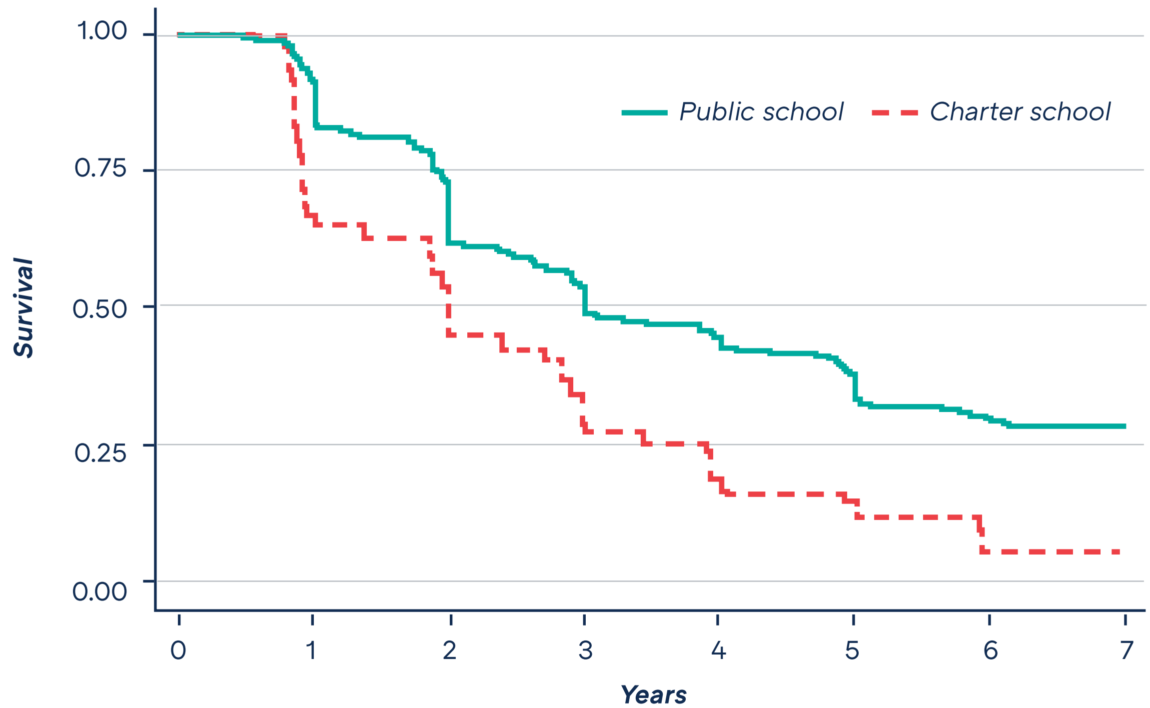
**FIGURE 9. Survival curves disaggregated by school's Title 1 eligibility (during the 2011-2012 academic year). N = 269.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Not Title 1 eligible | 78 | 73 | 58 | 46 | 38 | 33 | 24 |
| Title 1 eligible | 191 | 160 | 127 | 88 | 71 | 57 | 40 |

**FIGURE 10. Survival curves disaggregated by school type (during the 2011-2012 academic year). N = 3,946.**




*Number at risk:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Traditional public school | 232 | 210 | 168 | 124 | 104 | 87 | 62 |
| Public charter school | 46 | 31 | 22 | 14 | 9 | 6 | 3 |

**Table 5. Cox Proportional Hazards Models (N = 249).**

| VARIABLE | HAZARD RATIOS |
|---|---|
| **Individual-level variables** | |
| Gender (Reference: Female) | |
| Male | 0.862 |
| Race/Ethnicity (Reference: White) | |
| Black[a] | 1.452 |
| Other (Hispanic, Asian, Multi-racial)[a] | 0.933 |
| Age when hired (Reference: Age < 30) | |
| 30 ≤ Age <40 | 0.584 |
| 40 ≤ Age <50 | 0.631 |
| 50 ≤ Age[a] | 1.096 |
| Years of work experience[b] | 1.000 |
| Highest educational level (Reference: BA)[c] | |
| MA | 0.856 |
| Doctoral / Specialist[a, d] | 1.462 |
| Annual salary[e] | 0.860*** |
| Cumulative hours of professional development[f] | 0.942*** |
| **School-level variables** | |
| Urbanicity (Reference: Rural)[g] | |
| Town | 1.457 |
| Suburb | 1.091 |
| City | 1.815 |
| School size (Reference: Under 1,000 students)[h] | |
| 1,000 or more students | 0.963 |
| Title 1 eligibility (Reference: Not eligible)[g] | |
| Eligible | 1.189 |
| School type (Reference: traditional public school)[g] | |
| Public charter school | 0.723 |
| % of minority students[h] | 1.008 |

Note: The hazard ratios and significance may not be accurate due to the small sample size (N=249).

[a] These groups have a small sample size (<50).

[b] Years of work experience when hired.

[c] Highest educational degree when the event occurred.

[d] An educational specialist degree (e.g., Ed.S.) is a terminal professional degree for individuals who have already completed a master's degree in education.

[e] Salary (before deductions) when the event occurred, in units of $6,000 annually (or $500 monthly).

[f] Cumulative hours of professional development when the event occurred, in units of 10 hours. Only ACT 48 professional development courses were included in the analysis.

[g] During the 2011-2012 academic year.

[h] Calculated by averaging information from the 2011-2012 academic year to the 2016-2017 academic year.

*p<.05  **p<.01  ***p<.001

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