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Smoothing the Transition to Postsecondary Education: The Impact of the Early College Model

Julie A. Edmunds[a], Fatih Unlu[b], Elizabeth Glennie[c], Lawrence Bernstein[d], Lily Fesler[e], Jane Furey[b], and Nina Arshavsky[a]

ABSTRACT
Developed in response to concerns that too few students were enrolling and succeeding in postsecondary education, early college high schools are small schools that blur the line between high school and college. This article presents results from a longitudinal experimental study comparing outcomes for students accepted to an early college through a lottery process with outcomes for students who were not accepted through the lottery and enrolled in high school elsewhere. Results show that treatment students attained significantly more college credits while in high school, and graduated from high school, enrolled in postsecondary education, and received postsecondary credentials at higher rates. Results for subgroups are included.

KEYWORDS
high school reform
experimental study
postsecondary education

The changing nature of the U.S. economy has fostered concerns that too few students are successfully completing postsecondary education (Achieve, 2004). An estimated three quarters of those who enter high school graduate within four years, with approximately 70% of those graduates enrolling immediately in some form of postsecondary education (Ross et al., 2012). Of those students who do enroll, only about half (49%) attain some type of postsecondary credential within six years (Ross et al., 2012). As a result, there have been numerous initiatives to increase the number of students who graduate from high school prepared to enroll and progress in postsecondary education.

One approach is the early college high school (early college) model, small schools that blur the line between high school and college. Early colleges are a comprehensive model of schooling explicitly focused on college readiness for all (Edmunds, 2012). They are designed to incorporate characteristics that have been associated with increased enrollment and success in postsecondary education. In early colleges, all students take a curriculum that includes the courses necessary for entrance into a four-year university (Finkelstein & Fong, 2008). Students are given early access to college courses, which some studies have associated with improved postsecondary outcomes (Allen & Dadgar, 2012; An, 2013). Teachers receive

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support in implementing instructional strategies designed to prepare students for the level of thinking they will need to do in college (Conley, 2011). Students also receive explicit instruction and assistance in navigating the college admissions and financial aid processes (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2009; Tierney, Bailey, Constantine, Finkelstein, & Hurd, 2009).

Early colleges are a rapidly expanding model: at least 280 were started in 31 states and the District of Columbia under the National Early College Initiative, supported by the Bill and Melinda Gates Foundation. Although this initiative has ended, early colleges have continued to expand and are of great interest to policymakers: the 2014 National Early College Conference attracted 700 participants, including some from as far away as Japan. As of 2015, the U.S. Department of Education had awarded approximately $70 million under its Investing in Innovation program to five grantees to implement early colleges in multiple settings.

This paper presents results from the first longitudinal, prospective experimental study to examine the impact of early colleges on students' outcomes in high school and postsecondary education. The findings reported here are related to high school outcomes that are associated with a successful transition to college and to postsecondary outcomes. We present both overall results and findings for various subgroups of students, including the populations targeted by the initiative.

Theoretical Background

Many students face challenges enrolling and succeeding in college, particularly students who are the first in their families to attend college, are members of specific minority groups, or are low income (Grodsky & Jackson, 2009; Ross et al., 2012). Many do not enroll due to a lack of academic preparation or failure to complete the steps involved in applying for college and financial aid (Castleman, Owen, & Page, 2015; Tierney et al., 2009). Research suggests that there are specific actions schools can take to increase students' likelihood of enrolling and succeeding in college. This section provides an overview of the literature regarding college access and success, focusing on those actions. It then describes the components of the early college model that are expected to have an impact on college access and success, concluding with an overview of the research on early colleges.

School Characteristics Associated With College Access and Success

Among the characteristics associated with college access and success are academic preparation, early access to courses that carry college credit, a college-going culture, and assistance with logistical preparation.

Academic Preparation

Inadequate academic preparation prevents many students from entering college (Tierney et al., 2009). Many colleges require that students complete a specific set of courses to be eligible to apply. If students do not take these courses at the beginning of high school, it can be extremely challenging to complete them by the time they graduate from high school. For example, one study of students' transcripts in California found that, of the students who had not completed Algebra I by the end of the ninth grade, only an estimated 6% completed the courses they needed to go to college (Finkelstein & Fong, 2008). Additionally, correlational studies have shown that one of the strongest predictors of success in college is the extent to which students take more advanced courses that are seen as being necessary for college (Adelman, 2006; Adelman, Daniel, & Berkovits, 2003). As a result, researchers recommend creating a coherent academic program that will prepare high school students for college (Conley, 2005; Tierney et al., 2009).

In addition to a core set of courses, college success requires that students possess a certain set of intellectual skills, such as critical thinking and writing (Conley, 2008). Therefore, policy organizations have called for high schools to help students develop these skills through rigorous classroom instruction and a more intellectually focused school culture (Achieve, 2004; Conley, 2011).

Early Access to College-Credit-Bearing Courses

Offering students early access to college courses, through either Advanced Placement (AP) or dual-enrollment options, has long been a tradition in America's high schools. Initially limited to the most academically proficient students, AP and dual-enrollment courses have been expanding dramatically under the belief that these programs will increase students' readiness for college and decrease the time required to obtain a postsecondary degree (Iatarola, Conger, & Long, 2011; Speroni, 2011a). Researchers examining the relationship between these courses and postsecondary outcomes have found mixed results, with some studies finding positive associations with postsecondary enrollment and performance and others finding none.

For example, a study of the College Now program in New York compared outcomes for students who had taken at least one college course in high school to those for students who had not taken any, controlling for preexisting differences in achievement and other measures. This study found that taking college courses in high school was associated with a higher college GPA and higher credit attainment in college (Allen & Dadgar, 2012). Other studies using a similar approach with national data found that dually enrolled students were more likely to be college ready and to have higher first-year college GPAs (An, 2013; An & Taylor, 2015). In contrast, an analysis of Washington State's Running Start program found that taking dual-enrollment courses had a positive impact on attaining an associate degree but negative impacts on high school graduation and four-year college enrollment (Cowan & Goldhaber, 2015). All of these studies utilized regression models that attempted to control for baseline characteristics. Another study used a rigorous regression discontinuity design to determine the impact of dual enrollment on students whose GPAs were just above the minimum required for eligibility. This study found no overall impact on enrollment in, or completion of, postsecondary education, with the exception of a large impact on postsecondary attainment for those students who barely met the GPA eligibility requirement for college algebra (Speroni, 2011b).

College-Going Culture

Students are more likely to attend college when they are in a school environment that views college attendance as a priority (Koyama, 2007; Mehan, Hubbard, & Villanueva, 1994; Roderick, Nagaoka, Coca, & Moeller, 2008). In a longitudinal correlational study of college-going among Chicago students, the single most important predictor of a student's enrollment in college was the extent to which the high school had a college-oriented culture, including whether the staff encouraged students to go to college, tried to help students prepare for college, and assisted students in completing college applications. Having a college-going culture was particularly important for students with lower academic qualifications and those of Latino background (Roderick et al., 2008). Other studies have found that students who are in a school environment that values academics and college do better in school and have better postsecondary outcomes (Koyama, 2007; Mehan et al., 1994). One extensive ethnographic study found that, in a college-oriented high school, a caring school environment was also associated with increased college attendance. An ethic of caring, represented by teachers who wanted students to do well academically and socially, was particularly important for minority students (Knight-Diop, 2010).

Logistical Preparation

The actual process of applying to college includes multiple steps that students are often unable to navigate, such as taking appropriate placement exams, identifying colleges that are a good match for them, and completing applications (Roderick et al., 2008). This can result in otherwise well-prepared students not enrolling in college (Castleman et al., 2015). Many students face economic challenges to attending college (Bozick & DeLuca, 2011) and research has shown that providing explicit guidance on seeking out and applying for financial aid can result in increased college enrollment (Bettinger et al., 2009). For these reasons, the *IES Practice Guide on Helping Students Navigate the Path to College* (Tierney et al., 2009) recommends that high schools have processes in place to help students through these steps.

The Early College Model

Much of the research described above has focused on individual strategies (such as taking dual-credit courses) or a small combination of them. The early college model combines these strategies and others to create a learning environment focused on college readiness. This section describes how early colleges, which have been studied with a rigorous experimental design, incorporate various strategies in an effort to increase the number of students who enroll and succeed in college.

The early college is a comprehensive school reform model that focuses explicitly and purposefully on preparing all of its students for college (Edmunds, 2012). Early colleges provide students with concurrent high school and college experiences, substantially minimizing the transition between these two stages of education. Below, we describe the early college model as implemented in North Carolina, the site of this study, and summarize existing research on the model.

Primarily located on the campuses of two- or four-year colleges and universities, early colleges are targeted at students who are underrepresented in college. The goal is to minimize challenges in the transition to postsecondary education for students for whom access has historically been problematic. In North Carolina, the targeted populations include students who (a) are the first in their families to go to college, (b) come from low-income families, and/or (c) are members of racial and ethnic groups that are underrepresented in college.

Early colleges are expected to provide an academically rigorous course of study with the goal of ensuring that all students graduate with a high school diploma and two years of transferable college credit or an associate degree. In order for students to accomplish this goal, the early college must develop, in collaboration with their higher education partners, an aligned, seamless curriculum plan offering the high school and college courses that students need in order to complete both degrees, including dual-credit courses. Some early colleges are structured as four-year schools, but most allow students five years to complete the curriculum, having recognized that students who are members of the target populations may not always be able to complete all of the necessary credits in only four years.

Each early college is also expected to implement and exhibit a specific set of principles, known as design principles, developed by North Carolina New Schools (the public–private partnership that managed these schools in North Carolina), which represent characteristics of high-quality high schools. These design principles are as follows: (a) ensuring that students are ready for college, (b) instilling powerful teaching and learning in schools, (c) providing high student/staff personalization, (d) redefining professionalism, (e) leadership, and (f) implementing a purposeful design (North Carolina New Schools, 2013).

These design principles incorporate practices that are associated with increasing the number of students going to college. In particular, the college-ready design principle is intended to ensure that each school has a goal of preparing all its students for college, which is implemented by having a clearly articulated curriculum that could result in students receiving all of their high school credits and two years of college credit by the end of high school. All students are expected to take a default college preparatory course of study so that, by the time they graduate from high school, they will have all of the courses required for entrance into the University of North Carolina system. All students are also expected to take college courses. For most, this starts in the ninth grade[1] when they might take courses such as physical education or college success skills, often in classes composed only of early college students. In 10th grade, most early college students begin to take core academic courses along with regular college students. By 11th and 12th grade, students take the majority of their courses on the college campus along with regular college students.

The college-ready design principle also includes an emphasis on continuing college past the early college experience. Early colleges provide visits to other colleges and universities and support students in navigating the college admissions process. For example, students in many early colleges are required to complete applications to postsecondary institutions.

Other design principles provide supports intended to prepare students for college. The personalization design principle focuses on providing the academic and social supports that students need to succeed in a strongly academically oriented environment. The powerful teaching and learning design principle includes instructional strategies that provide the type of rigorous and relevant instruction that students will likely encounter in college classes. The principle of purposeful design entails locating the early colleges on the campus of two- and four-year colleges. This allows students to directly experience the college enviroment and to be a college student while still in high school. The other two design principles focus on the professional working environment and provide more indirect support for the goal of college readiness. Figure 1 provides a conceptual model of the early college components theorized to most directly impact students' enrollment and success in college.

Research on Early Colleges

Although the number of early colleges is growing, they are a relatively recent phenomenon with a limited research base. One of the first studies of early colleges was a national

[1] Most colleges require students to pass a placement exam before taking specific college courses; students who fail may be able to take developmental (remedial) courses, whose successful completion will allow enrollment in college courses. Early college students must meet the same conditions, and not all do so. Early colleges can struggle to serve students who are not allowed to take college courses. In some cases, these students transfer to traditional high schools.

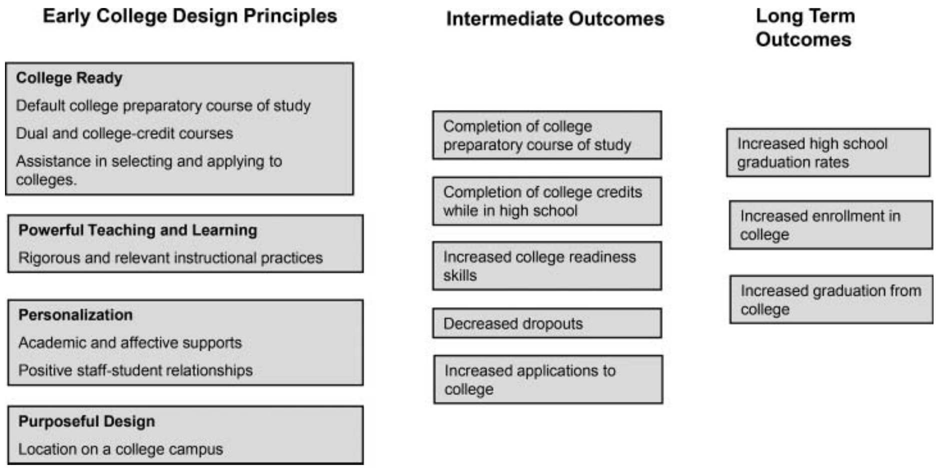

Figure 1. Early college theory of change relative to college readiness.

evaluation of the model, comissioned by the Bill and Melinda Gates Foundation, that focused on describing implementation and outcomes for early college high schools across the country. According to the evaluation, most were new schools located on the campus of, and working with, community colleges. Results showed the model serving its intended population with approximately two thirds of students being racial or ethnic minorities and 59% coming from low-income households. The national evaluation also found that early college students did better overall than other students in the district in which the early colleges were located, although the original research design was unable to control for alternative factors such as incoming achievement or motivation (American Institutes of Research & SRI International, 2009).

Much of the research on early colleges consists of small-scale descriptive or qualitative studies (including a number of dissertations) that investigated aspects of the early college experience. For example, some studies have concluded that the early college is a personalized learning environment (Thompson & Onganga, 2011), providing students with care, support, and high expectations (Bruce, 2007).

Very few studies have attempted to determine the impact of the early college model, beyond a descriptive summary of the outcomes in the school as compared to national, state, or university averages (e.g., American Institutes of Research & SRI International, 2009; Hall, 2008). One did identify a comparison group of students (based on race/ethnicity, gender, and previous achievement) for a cohort of students in a single early college (Kaniuka & Vickers, 2010). This study found that students from the early college scored higher on standardized tests than the matched comparison group in the regular high school. To date, however, there have been only two experimental studies conducted on this model, the first of which is represented by this paper.

The second, an experimental study, supported by the Bill and Melinda Gates Foundation and conducted by the American Institutes of Research (AIR), utilized a retrospective experimental design for a sample consisting of 10 sites across the country that used lotteries to select their students, and included students who entered ninth grade in 2007–2008 or earlier. The study found a positive impact on achievement in English Language Arts, no impact on mathematics achievement, and a five percentage point impact on high school graduation rates (Berger et al., 2013). There were also positive impacts on postsecondary enrollment. By the end of the sixth year after high school, 80.9% of early college students had enrolled in postsecondary education at least once (including enrollment in dual-credit courses in high school) compared to 72.2% of the comparison group (Berger, Turk-Bicakci, Garet, Knudson, & Hoshen, 2014).

The study reported in this paper is a prospective, longitudinal, experimental study of the early college model as implemented in North Carolina. Funded by three consecutive grants from the Institute of Education Sciences, our study has tracked students in real time beginning in ninth grade. As reported elsewhere, we have found that early college students were more likely to be progressing in core college preparatory classes, particularly in mathematics. They also had better attendance and lower suspension rates, and were more likely to remain in school (Edmunds, Bernstein, Unlu, Glennie, Smith, et al., 2012; Edmunds, Bernstein, Unlu, Glennie, Willse, et al., 2012). The study also found that early college students reported more positive learning experiences than control group students, including higher expectations, better relationships with their teachers, more rigorous and relevant instruction, and more frequent support (Edmunds, Willse, Arshavsky, & Dallas, 2013).

Our study has several advantages that allow us to make a significant contribution to the research on early colleges and, more broadly, to the research on programs and reforms seeking to boost postsecondary preparation and enrollment. First, this study is based on a well-planned and implemented lottery-based experimental design, which yields results with strong internal validity. Second, tracking students as they progress through high school allows us to capture a rich array of outcomes at both the high school and college levels, only a small portion of which can be described in this paper. Third, we utilize established administrative data sources that allow us to capture these outcomes reliably and consistently over time. Finally, our study's full sample includes students who enrolled in ninth grade in the years 2005–2006 through 2010–2011. This means that it includes data from schools in their first, second, third, fourth, and fifth years of implementation; thus, we are able to include more mature schools. The next section provides more detail on the methodology.

Methodology

This study is based on a multisite randomized field trial designed to examine the impact of early colleges on core student outcomes. The purpose of this paper is to examine the impact of the model on both intermediate high school outcomes associated with improved college access and success—such as college credits attained while in high school and high school graduation—as well as on the longer-term outcomes of postsecondary enrollment and degree attainment. The specific research questions addressed in this paper include the following:

1. What is the impact of the early college model on high school outcomes associated with students' success and enrollment in college, including college credits earned while in high school and high school graduation rates?
2. What is the impact of the early college model on key postsecondary outcomes, including students' enrollment in postsecondary education and their attainment of postsecondary credentials?
3. Does the impact significantly vary for different subgroups, including students who are low income, the first in their families to go to college, members of underrepresented racial or ethnic groups, or not prepared for ninth grade?

To answer these questions, the study uses extant data for students who applied to and were randomly selected to attend the early college. More specifically, early colleges included in this study utilized a lottery to select students from an applicant pool, and the study compares the students assigned to the treatment group (early college) with students assigned to the control group (generally the traditional high school in the district, or "business as usual").

Sample

This paper reports on results from 12 early colleges, including all schools that had enrolled in the study by the 2008–2009 school year. These schools are located in rural and urban settings in all regions of North Carolina. On average, they are much smaller than the traditional schools in their counties, but serve students who are similar to the student populations in their districts in terms of eligibility for free- and reduced-price lunch and race/ethnicity. The early colleges do have much lower enrollments of students with disabilities and they enroll students with higher initial levels of achievement. Although early colleges and traditional high schools have similar teacher turnover rates, early colleges are much more likely to have teachers who are in their first three years of teaching. Table 1 presents characteristics of the early colleges included in this study and the high schools located in the same districts.

The student sample analyzed for this paper includes a total of 1,651 students who applied to 12 different early colleges and enrolled in ninth grade in the 2005–2006, 2006–2007, 2007–2008, and 2008–2009 school years. These 12 schools enrolled a total of 18 cohorts of students, with five schools enrolling multiple cohorts. To participate in the study, schools had to have more applicants than available slots, and had to agree to use a lottery to randomly assign students. Schools could set aside slots for students whom they wanted to accept, such as siblings, but any student who did not go through the lottery was excluded from the analysis. Schools entered the study on a rolling basis and, as long as they continued to use the lottery, could continue to contribute cohorts of students to the study. Because we use extant administrative data (more detail is provided in the measures section), we are able to include almost all students from the original lottery samples in our analyses. Table 1 also includes data showing how the early colleges in our study compared to the early colleges in North Carolina that were not in our study.

Table 1. Characteristics of participating early colleges, traditional schools, and nonparticipating early colleges.

Characteristics		Early colleges participating in study	Traditional schools in same districts as participating early colleges	Early colleges not participating in study
School	Size	142.1	971.5	131.5
Student	% Eligible for free and reduced-price lunch	50.8%	45.7%	46.4%
	% Minority	40.0%	44.4%	39.0%
	% Special education	3.9%	9.2%	3.5%
	% Academically gifted	17.6%	17.5%	18.0%
	Incoming achievement % passing end of Grade 8 math	83.0%	65.8%	82.6%
	Incoming achievement % passing end of Grade 8 English exam	86.8%	78.6%	88.2%
Teacher	Teacher turnover rate	17.0%	13.9%	15.8%
	% novice teachers	30.2%	17.2%	31.4%

Note. The characteristics of schools in the study include students who are not in the randomized sample and were accepted to the school under another process. As a result, these percentages may differ from those in Table 2.

In lotteries conducted for the early colleges, each applicant who met the school's eligibility criteria was assigned a random number and the list of students was ordered from lowest to highest, with the lowest numbers being selected into the early college until all available slots were filled. Beginning with the 2007–2008 cohort, the research team began conducting the lotteries. Before then, two schools in the first two cohorts conducted the lottery themselves. For some schools, stratified lotteries were conducted, which led to different probabilities of selection into the treatment condition. All analyses take these differences into account by utilizing weights based on students' probability of being selected into an early college.

We examined baseline characteristics of the treatment and control students included in the main analytic sample to determine if there was a statistical balance on observable characteristics between the two groups. Table 2 shows the eighth-grade demographic characteristics of the full sample. As seen, the treatment and comparison groups are statistically comparable on all of the characteristics examined, with the exception of being retained in elementary or middle school and passing the eighth-grade math exam. All of the measures displayed in Table 2 were used as covariates in the regression model employed to estimate impacts. As described in more detail below, the analysis samples for two outcome measures (high school graduation and accumulated college credits) were slightly smaller than the main analytic sample. Appendix Tables A2 and A3 show that none of the treatment vs. control differences were statistically significant in those samples.

As in most experimental studies, some individuals did not comply with the random assignment (i.e., treatment students who did not enroll in the early college they were selected into and control students who did enroll in an early college). In the main analytic sample, the compliance rate was 87% for treatment students (i.e., a 13% no-show rate) and 98% for control students (i.e., a 2% crossover rate) yielding an overall average compliance rate of 92%.

Table 2. Sample characteristics by treatment status.[a,b]

	Whole sample ($N = 1651$)	Treatment group ($N = 938$)	Control group ($N = 713$)	T-C difference		
	Mean	Mean	Mean	Difference	P value	Effect size
Race/ethnicity						
Black	26.7%	27.4%	25.8%	1.7%	0.45	0.05
Hispanic	8.3%	9.2%	7.0%	2.2%	0.10	0.18
White	60.2%	59.1%	61.6%	−2.6%	0.30	−0.06
Gender						
Male	41.0%	40.6%	41.6%	−0.9%	0.71	−0.02
Socioeconomic background						
First-generation college	40.8%	41.1%	40.5%	0.6%	0.82	0.01
Free/reduced-price lunch eligibility	50.7%	51.3%	49.9%	1.5%	0.56	0.04
Exceptionality						
Disabled/impaired	2.9%	2.4%	3.5%	−1.1%	0.21	−0.23
Gifted	14.8%	13.9%	15.9%	−2.0%	0.26	−0.10
Retained	4.1%	3.1%	5.5%	−2.5%	0.01*	−0.37
Eighth-grade achievement						
Math—Z score	0.00	−0.03	0.03	−0.06	0.23	−0.06
Reading—Z score	−0.01	−0.02	0.01	−0.03	0.52	−0.03
Math—pass	80.2%	82.0%	77.9%	4.1%	0.04*	0.16
Reading—pass	79.5%	79.3%	79.7%	−0.4%	0.84	−0.02

[a]The proportions are weighted by students' probability of being selected into the ECHS.
[b]This is the core analytic sample used for many outcomes and excludes students who could not be found in the 9th–grade administrative data and students missing demographic data.
*Statistically significant at $p < .05$.

This is much higher than the compliance rate for AIR's study, in which 22% of the sample were no-shows and 2% were crossovers (Berger et al., 2013).

Measures

The outcomes examined in this paper are based on the early college theory of change (Figure 1), including one intermediate outcome (college credits accrued) and all three of the longer term outcomes (high school graduation, postsecondary enrollment, and postsecondary degree attainment). The data used in our analyses come from administrative data collected by three primary sources: the North Carolina Department of Public Instruction (NCPDI), the National Student Clearinghouse (Clearinghouse), and the North Carolina Community College System. The North Carolina Education Research Center at Duke University merged these data with the data collected by the study team from lottery applicants and de-identified the resulting data set for analyses. The student outcome measures and samples are described in more depth below.

College Credits Earned While in High School

One of the main theories of change underlying the early college high school is that early exposure to college courses makes students more likely to succeed in college. This is based on research, summarized in the previous section, that shows an association between receipt of college credits and positive postsecondary outcomes (Adelman, 2006; An, 2013; Karp, Calcagno, Hughes, Jeong, & Bailey, 2007).

Although access to college courses is embedded in the design of the early college model, students in comprehensive high schools also have access to college credits through dual-enrollment courses and through Advanced Placement exams or International Baccalaureate (IB) exams. Because the initial goal of the early college was to facilitate the transition to a four-year college or university, we focus in this paper on college credits that could be transferred to a four-year institution. Students were given three college credits for each college course they took and passed, with passing defined as receiving at least a "C" in the course because this is the minimum grade required for transferring credit. In looking at college courses, we identified those courses that were transferable to a four-year institution; therefore, we excluded vocational courses and those that were remedial or developmental courses. Students in our sample also had the opportunity to gain college credit by passing Advanced Placement exams. Because the number of credits earned can vary according to the institution, the topic of the exam, and the score received, we selected the University of North Carolina at Greensboro (UNCG) as typical of the colleges in which early college graduates might enroll, and used its AP credit guide to assign appropriate levels for credit for each exam. Under UNCG's guidelines, for example, students who attained a score of 3 on the AP Chemistry exam received four credits while students who attained a 4 or 5 received eight credits. Students who took Comparative Government and Politics received three credits for a score of 3 or higher.

Data on college course-taking come from the North Carolina Community College system, which provided information on courses taken and grades received for students who were enrolled in a community college while in high school. This does mean that we did not include any credits earned through four-year colleges; however, our data show that only 36 students in our sample enrolled in four-year colleges while they were in high school, so our results should not be influenced by the absence of these data. Data on AP exam performance come from NCDPI. These data were available for 2009–2010 and subsequent years. Because AP exam data were not available for earlier years, we ran sensitivity analyses that excluded 248 students who would have been in 11th and 12th grades (the years in which most students take AP classes) prior to 2009–2010. These analyses (results provided in Appendix Table A4) showed very little difference and actually result in a higher impact estimate in comparison to our main analyses; as a result, we feel confident in including the full sample of students in our college credit analyses. We also did not have data on IB exam performance; however, given that only six students in our sample took IB courses, we do not believe that this is problematic. Finally, although many early colleges are five-year programs, to ensure a similar comparison with students in traditional schools, we examined the number of college credits completed only through the end of 12th grade. The sample for this outcome is 1,437 students and excludes students who could not be matched originally to the NCDPI data, who transferred to a private school or another school out of state, or who were missing (i.e., could not be matched to the administrative data) in any grade. Students who dropped out or graduated early remained in the analyses.

Graduation From High School

High school graduation is almost always a necessary precursor to attending college and attaining a college degree. Even if a student does not continue to postsecondary education, a high school diploma provides increased personal and societal benefits compared to dropping out of high school (Carroll & Erkut, 2009; Levin, Belfeld, Meunnig, & Rouse, 2006). For this study, we report five-year graduation rates because the majority of early colleges are five-year programs and even early colleges that are four years by design do allow some students to take five years to graduate. We recognize that this gives students in the traditional high school an extra year to graduate, which has the potential to depress our overall impact estimates, but this is the time point that provides the fairest comparison. We included only those students who received a regular high school diploma (certificates and GEDs were not included). The graduation data come from the NCDPI Graduate Data Verification System, which is designed to collect the names, demographic information, course of study, and post-graduate intentions of North Carolina high school graduates, and to provide each local education agency with an authoritative list of graduates. Only students who have graduated are included in the file. Students who were verified as having moved to another school system (either home-schooled, private, or out of state) were removed from the sample. All other students who were not present in the graduate file were considered to have not graduated.

The sample for this analysis includes all students who applied to the early college, were originally linked to the North Carolina administrative data, and did not transfer out of state or to a private school ($N = 1{,}594$). Students who were originally matched to the data but were later missing remain in the analyses and are counted as not graduating. Students who were documented as transferring out of state or to a private school were excluded from the analyses. This is consistent with the approach that NCDPI uses to calculate its cohort graduation rate.

Enrollment in Postsecondary Education

Although one of the long-term goals of early colleges is to increase students' enrollment in postsecondary education, their unique design poses a challenge to identifying appropriate postsecondary outcomes and comparisons (given that early college students are enrolled in high school and college at the same time). In selecting appropriate measures for this study, we sought to identify outcomes and measures that serve as fair and meaningful comparisons between the treatment and control groups. For example, looking at enrollment in postsecondary education while in high school did not seem to be an outcome that provides a fair comparison, given that early college students are required to take college classes and regular high school students are not. Thus, this outcome could be seen as overly aligned with the treatment. On the other hand, examining enrollment in postsecondary education only after graduation from high school would discount all of the postsecondary experience gained by students while in the early college, and would not include results for students who attained their two-year degree while in high school. The outcome we report in this paper is whether a student was ever enrolled in any type of postsecondary education (part-time or full-time). This enrollment could occur at any point over the time period from ninth grade through the fall semester of the sixth year after the student started high school. This approach acknowledges the nature of the early college design while also giving students in the control group time to "catch up."

The source of data for this outcome is the National Student Clearinghouse (Clearinghouse). The Clearinghouse collects data representing approximately 94% of students enrolled in postsecondary institutions in the United States and provides information about enrollment by semester, the institution in which a student is enrolled, and type and date of any degrees received. The Clearinghouse linked our applicant data to their files using name and birth date.

If a student was not present in the Clearinghouse data, we considered him/her not to be enrolled in postsecondary education. A student could be absent from the Clearinghouse data for several reasons: (a) the student did not attend a postsecondary institution at all; (b) the student attended a postsecondary institution that does not report to the Clearinghouse; (c) the student opted out of having his/her data shared, or (d) the name and/or birth date used for matching with Clearinghouse records was incorrect (Dynarski, Hemelt, & Hyman, 2015).

Our outcome measure as constructed would underestimate postsecondary enrollment under scenarios 2 through 4. In North Carolina, scenario 2 does not appear to be very likely, as the Clearinghouse covers 96% of four-year institutions and 99% of two-year institutions in the state (National Student Clearinghouse Research Center, 2013), although it is possible that students could enroll out of state in an institution that does not report to the Clearinghouse. The third scenario is a possibility. In North Carolina, less than 1% of students in two-year institutions but approximately 10%–12% of students in four-year institutions opted out of having their data shared (National Student Clearinghouse Research Center, 2012). We attempt to mitigate this concern by resubmitting the same list of names for multiple years because students' permissions can change over time (Dynarski et al., 2015). We also have no reason to believe that treatment and control students differ in their likelihood to opt out of providing data. Similarly, scenario 4 is also a possibility, especially given the fact that an exact match on name and birth date is required to produce a "hit" in the Clearinghouse data. To reduce this possibility, we engaged in various strategies including double checking our application data against the NCDPI data and submitting common variations in spellings of the same name (e.g., John, Jon, Jonathan, Jonathon, etc.). Because we used the same strategies for checking names for both our treatment and control groups, we do not believe that students in either group would be more or less likely to be absent from the database because of incorrect names or birth dates. Despite the fact that we are using the same approaches for both treatment and control groups to minimize the impact of reasons c and d, numerically more treatment students may be affected by these reasons if, as we expect, more treatment students enroll in postsecondary education. As a result, any impact estimates may be considered conservative. The sample for this analysis includes all students who applied to the early college and were linked to the NCDPI data ($N = 1{,}651$).

Postsecondary Degree Attainment

Another long-term goal of early colleges is to increase the number of students who receive postsecondary degrees. Ideally, we would examine this outcome for both two- and four-year institutions at a point in time that is at least 10 years after the students entered high school (four years of high school plus an additional six years to attain a bachelor's degree). However, our current sample only goes through the sixth year after students' entrance into high school, or through two years after the student's graduation from high school, if they graduated on time (in four years). This allows two years for students in two-year institutions to complete their degrees.

We report two sets of outcomes. The first is attainment of any type of postsecondary credential, including associate degree, technical credential, or bachelor's degree. We also separately analyze obtaining a degree in each of the three specific categories of credential. It should be noted that attainment of a bachelor's degree is not necessarily an expected outcome of the program at this point in time, as it would reflect an extremely accelerated time line. The data for this outcome also come from the Clearinghouse. The sample for this outcome is the same as for the postsecondary enrollment outcome.

Figure 2 tracks the sample from random assignment through the various outcomes.

Subgroups

Because early colleges were specifically designed to increase postsecondary access and success for underrepresented populations, we examine the results for those target populations, as well as one additional subgroup. The four subgroups are:

1. Underrepresented minorities. Students who are members of specific racial and ethnic minority groups are less likely to attend and complete postsecondary education (Adelman et al., 2003; Ross et al., 2012). As a result, this is one of the early colleges' target populations. For purposes of this study, we identified students who are members of minority groups underrepresented in the North Carolina university system, which includes students who identify as African American, Hispanic/Latino, or Native American. Students who are White, Asian, or Multiracial are not considered as underrepresented.
2. First-generation college-goers. Another target population of the early college model, first-generation college students are also much less likely to enter postsecondary education (Choy, 2001). We defined first-generation students as those whose parents had no exposure to postsecondary education. Any student whose parents enrolled for any length of time in a two- or four-year college is not considered to be a first-generation student.
3. Low-income students. The third target population is low-income students, a group that also faces substantial challenges in enrolling in college (Bailey & Dynarski, 2011). These students are defined as those who qualify for free and reduced-price lunch. Because high school students are less likely to enroll in free lunch programs (Riddle,

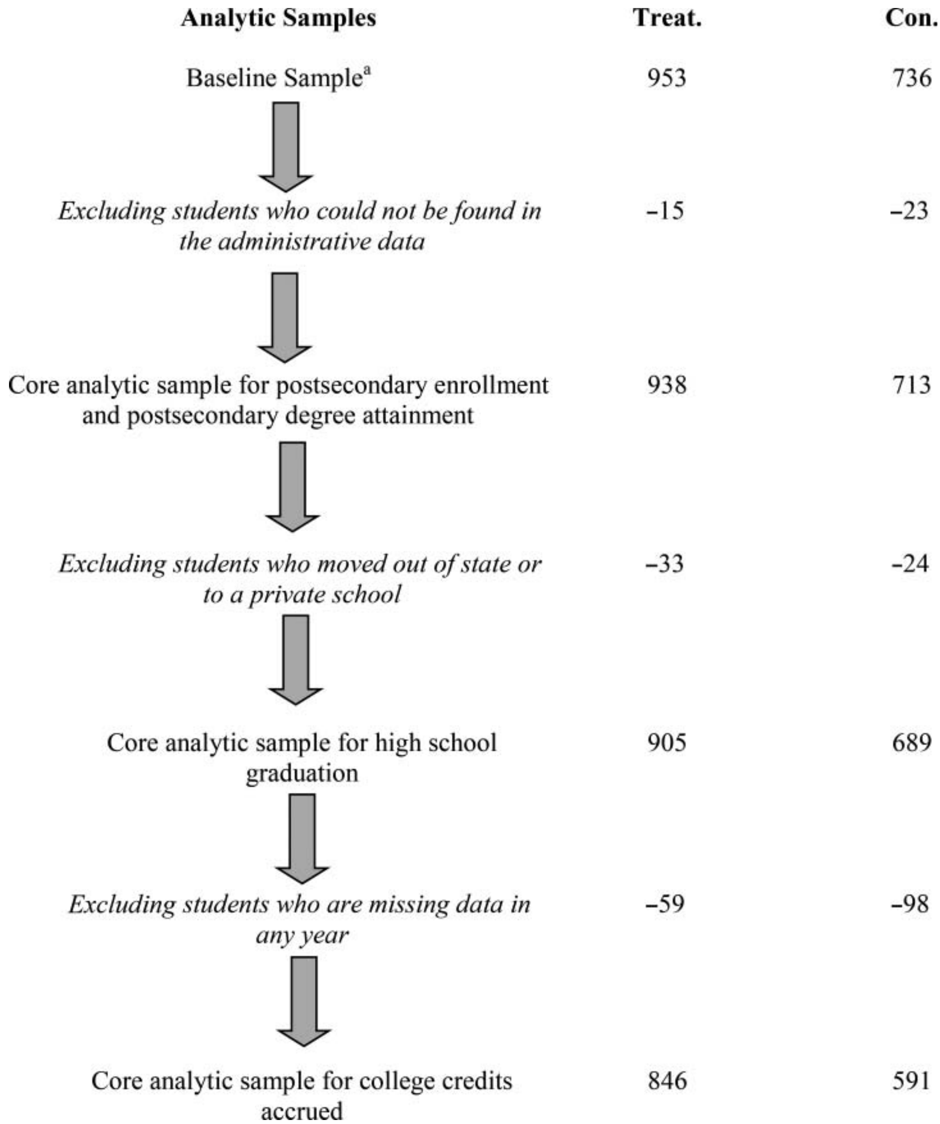

Figure 2. Sample tracking diagram, by outcome. [a]This sample includes all students who applied to enroll in an early college and participated in the random assignment except those who were retained in the 8th grade ($n = 4$).

2011), we use students' eighth-grade free and reduced-price lunch classifications to define this subgroup.

4. Not prepared for ninth grade. The final subgroup is composed of those students who are not academically prepared for high school. Although students in this subgroup are not specifically targeted by the initiative, it is important to examine whether they are differentially affected. Many practitioners have concerns about whether lower performing students can succeed in a model that accelerates them quickly into college courses; these students may even be screened out of some early colleges in North Carolina and elsewhere. Therefore, we present results for students who are not

prepared for ninth grade, defined as not passing the eighth-grade North Carolina standardized reading exam, the eighth-grade math exam, or both. Students in this sample would have received a Level I or II in reading, math, or both, which are counted as failing in North Carolina's end-of-grade exams. It should be noted that very few of these early college applicants had received a Level I, which would be considered substantially low-performing.

Analysis

The impacts of early colleges on these outcomes were estimated within an intent-to-treat (ITT) framework, in which a student's initial experimental status as a treatment or control student, rather than actual participation in an early college, served as the treatment contrast. Intent-to-treat is the standard for educational policy evaluations (Institute of Education Sciences, 2005) and maintains the integrity of the initial random assignment (Hollis & Campbell, 1999). We did not conduct analyses to estimate treatment-on-the-treated (TOT) or local average treatment effects (LATE) because the compliance rate was fairly high (92% in the overall sample), which suggests that LATE estimates would be about $1/0.92 = 1.09$ times the ITT estimates.

All of the applicants who applied to an individual early college within an individual year were considered participants in a "lottery." We calculated impact estimates using multivariate linear regression models that include lottery indicators (or lottery fixed effects), a treatment indicator capturing the initial group to which a student was randomly assigned, and baseline student characteristics including demographic characteristics such as gender, race/ethnicity, age, free/reduced-price lunch status, whether a student was retained prior to eighth grade, and eighth-grade academic performance. We included lottery fixed effects rather than random effects because our sample was purposefully selected and we are not seeking to generalize the results to a broader population (Raudenbush, Martinez, & Spybrook, 2007; Schochet, 2008). The statistical inference takes into account clustering of students within schools by calculating cluster-robust standard errors (also known as Huber-White sandwich estimate of the variance implemented using Stata's "vce(cluster *clustervar*)" option) estimated based on the early college or regular high school that a student attended the longest (Rogers, 1993; Wooldridge, 2002). This approach has also been used in other large-scale lottery-based studies (Abdulkadiroglu, Angrist, Dynarski, Kane, & Pathak, 2011; Angrist, Cohodes, Dynarski, Pathak, & Walters, in press; Bloom & Unterman, 2014; Cullen, Jacob, & Levitt, 2006).

Equation 1 represents a prototypical regression model for a continuous outcome,[2]

$$Y_{ij} = \beta_1 T_{ij} + \sum_{j=1}^{J} \beta_{2j} S_j + \sum_{n=1}^{N} \beta_{3n} X_{nij} + \varepsilon_{ij} \tag{1}$$

where:

Y_{ij} is the outcome of interest for student i in lottery j,
T_{ij} is the treatment indicator for student i in lottery j ($T_{ij} = 1$ if student i is assigned to the treatment group; $T_{ij} = 0$ otherwise),

[2] We use linear probability models for binary outcomes as well because they produce more easily interpretable results. We checked the robustness of these results using logistic regressions, which yield similar impact estimates.

S_j is a lottery indicator equal to 1 for students who participated in lottery j and to 0 otherwise ($j = 1 \ldots J$),

β_1 is the estimated average ITT treatment effect,

β_{2j} is the fixed effect for lottery j (i.e., the average outcome of the control students from lottery j),

X_{nij} is the nth characteristics of student i in lottery j, which is included as a covariate,

β_{3n} represents the relationship between the nth student characteristic and the outcome Y

ε_{ij} represents a random error term for student i in lottery j.

As mentioned above, this model is estimated using weights (i.e., weighted ordinary least squares) that are based on students' probability of being selected into the early college. We conducted a number of sensitivity analyses that implemented different model specifications (e.g., logistic models for binary outcomes, and estimating lottery-specific impact estimates, which were then pooled via various weighting options to yield the overall impact estimate). None of these analyses yielded substantially or substantively different results than those presented here. For all outcomes, we present the adjusted impact estimate, the unadjusted control mean, and an adjusted mean for the treatment group that is calculated by adding the adjusted impact to the unadjusted control mean. We also present the cluster-robust standard errors for the impact estimates.

The subgroup analyses were conducted by estimating a similar impact model for each subgroup of interest and the rest of the sample (i.e., separate impact models were run for first-generation college-goers and non-first-generation college-goers). Following Bloom and Michalopoulos (2010), we also report whether the impact for a given subgroup is statistically significantly different than the impact for the rest of the sample.

Results and Discussion

The results show that early colleges are having overall positive impacts on outcomes associated with a successful transition to college, including more college credits, increased postsecondary enrollment rates, and increased attainment of degrees. We present the results for the full analytic sample first, followed by results for the subgroups. Table A1 in the Appendix shows the unadjusted means and standard deviations for all outcome measures analyzed in this paper separately for the treatment and control groups.

Impact on College Credits

Analyses show a very large difference in the number of college credits earned by the two groups of students while they were in high school. Specifically, Table 3 shows that by the end of 12th grade, the treatment students had earned an average of 21.6 transferable college credits compared to an average of 2.8 credits earned by the control group ($p < 0.001$). This indicates that, on average, the treatment students had successfully completed approximately seven transferable college courses, or almost a full year's worth of college, compared to less than one course on average for the control group.

Early access to college credit is certainly a key part of the intervention, and the findings for this outcome show that the treatment was successfully implemented. However, high school students in comprehensive high schools are also able to enroll in college courses, through both dual-enrollment and Advanced Placement options. This study suggests that many students, even those who are theoretically interested enough in college to apply to a school called an "early college," do not enroll in college-credit-bearing courses during their experience in a regular comprehensive high school. Access may be an issue because many of these early colleges are located in rural areas, which historically give students less frequent exposure to courses such as Advanced Placement (Handwerk, Tognatta, Coley, & Gitomer, 2008). Early colleges may be particularly valuable in these rural communities because they can expand access to college-credit-bearing courses.

Impact on High School Graduation Rates

The impact on five-year high school graduation rates is positive but not statistically significant at conventional levels (4.0% with a *p* value of 0.15). This is somewhat similar to the impact estimates generated by AIR's study, which found a statistically significant impact of five percentage points (Berger et al., 2013). This relatively small and nonsignificant impact may be seen as somewhat disappointing given that early colleges are implementing many aspects of school design that are seen as promoting students' desire to stay in school (i.e, increased personalization, a challenging curriculum, and more rigorous and relevant instruction; Edmunds, Bernstein, Unlu, Glennie, & Smith, 2013). Placing these findings in the context of other research, however, shows that increasing high school graduation rates is very challenging and only a small number of interventions have shown positive impacts on graduation rates, particularly for regular high school students. Of the five interventions listed on the What Works Clearinghouse website in 2015 as having statistically significant positive impacts on completing high school, four were focused on students who had already dropped out of high school. The fifth, with a target population similar to that of the early colleges, reported impacts on completing school that included both GED attainment and traditional high school graduation rates. Experimental studies of other whole-school reform efforts such as Career Academies (Kemple, 2008) have found no positive impacts on graduation rates. On the other hand, a study of the small schools effort in New York City found a 6.8 percentage point impact on graduation rates (Bloom, Thompson, & Unterman, 2010) where 68.7% of treatment students graduated, compared to 61.9% of the control group. A follow-up with an additional cohort of students found that the positive impact on graduation rates had increased to 8.6

Table 3. Impact estimates, full analytic sample.

	N	Adjusted treatment mean	Unadjusted control mean	Impact estimate	Standard error[a]
College credits attained while in high school	1,437	21.6	2.8	18.8**	(1.06)
Graduation from high school	1,594	85.4%	81.4%	4.0%	(2.90)
Ever enrolled in postsecondary education	1,651	89.9%	74.3%	15.6%**	(2.60)
Ever enrolled in two-year institution		87.8	57.5	30.4**	(2.99)
Ever enrolled in four-year institution		38.4	32.3	6.2*	(2.15)
Attainment of any postsecondary credential	1,651	30.1%	4.2%	25.9%**	(3.34)
Attainment of associate degree		28.4	3.0	25.4**	(2.99)
Attainment of technical credential		1.9	1.3	0.59	(0.78)
Attainment of bachelor's degree		0.9	0	0.9**	(0.21)

[a]Cluster-robust standard errors calculated based on the ECHS or regular high school in which students attended the longest are presented in parentheses.
*Statistically significant at $p < .05$.
**Statistically significant at $p < .001$.

percentage points (Bloom & Unterman, 2012). Early colleges thus had impacts approximately half the size of the small schools, although it should be noted that the control groups in early colleges had a much higher graduation rate (81.7%) than the New York City control group (61.9% in the original cohort and 59.3% in the follow-up cohort). This higher baseline graduation rate meant that it was more difficult to see large changes.

Enrollment in Postsecondary Education

Given the increased number of college credits and the increased graduation rates, we should expect to see increased enrollment in postsecondary education, and we do. By the beginning of the sixth year after entering ninth grade, 89.9% of the treatment group had enrolled in postsecondary education at least once (including enrollment while in high school), compared to 74.3% of the control group, a statistically significant impact of 15.6 percentage points ($p \leq .001$). This is a higher percentage than reported by the Berger et al. (2014) study, which found that 80.9% of the treatment group, compared to 72.2% of the control group, had enrolled in college at least once between the start of ninth grade and the end of the study period. When we examine results for two- and four-year institutions separately, we see that the largest impact is on enrollment in two-year institutions. This is because the majority of early colleges in this study are located on community college campuses. It is possible that the increased enrollment in two-year institutions could come at the expense of enrollment in four-year institutions (see Cowan & Goldhaber, 2015); however, we also see a positive and statistically significant impact on enrollment in four-year institutions. Table 3 includes the percentage of students who had ever enrolled in postsecondary institutions by level.

Because both "ever enrolled in postsecondary education" and AIR's results (Berger et al., 2014) include high students' enrollment in college while they are in high school (an integral part of the intervention), we wanted to determine whether or not this enrollment was driven primarily by the design of the model. In other words, we wanted to know if students' exposure to college was simply being shifted to an earlier point in time. As a result, we looked at postsecondary enrollment on an annual basis. Figure 3 shows the percentage of students enrolling in postsecondary education in each year. This figure is cross-sectional, not cumulative as the "ever enrolled" outcome is.

As the cross-sectional analyses show, the enrollment in postsecondary education is primarily an artifact of the model's design, with very high percentages of students enrolled while in high school and declining enrollment after they leave the early college. As Figure 3 shows, the actual percentage of students enrolled in college two years after completing high school is lower in the treatment group than in the control group.

There are two primary explanations for this phenomenon. The first is that students are completing their associate degree or a technical credential and are going directly into the workforce. We find limited evidence to support this explanation given that only 16% of the students who do not continue to postsecondary education have their associate degrees.

We believe a more reasonable explanation is linked to recent research that suggests that a large number of students are "trying out" college (Bahr, 2011). Currently, approximately 84% of students enroll in postsecondary education within the first 10 years after graduating from high school, although many of them do not complete (Lauff & Ingels, 2014). Of those students who do not attain a degree or a credential, some can be seen as what Bahr defines as "experimental," saying, "These students appear to have 'tested the waters' of college and found those waters less than agreeable" (Bahr, 2010, p. 733). It is possible that some of the

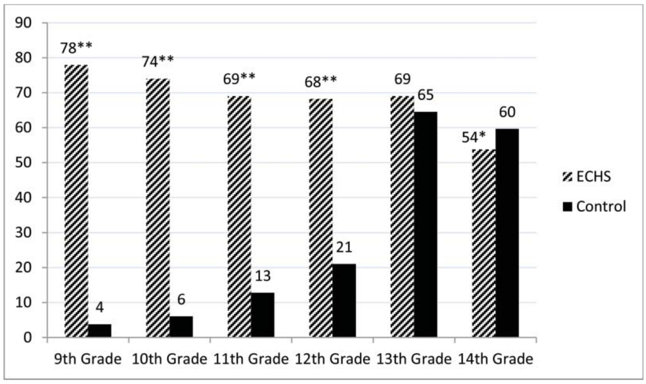

Figure 3. Percent enrollment in postsecondary education by year. The measure used to construct this graph is cross-sectional, not cumulative. The ECHS or Control bars for a given grade represent the percentage of students enrolled in postsecondary education in that grade. The Control bar is the unadjusted control group mean while the ECHS bar is the sum of the unadjusted control group mean and the impact estimate calculated using the impact model described in the main text. **Statistically significant at $p < 0.01$. *Statistically significant at $p < 0.05$.

early college students fall into this group; it is just that they "test the waters" while they are still in high school, before the trying-out period that may occur after high school for comprehensive high school students. In interviews we conducted with early college students who had decided not to continue on to further education after graduation, many commented that they were "tired of school" or "wanted a break," while others noted that their work plans did not require them to get any further education. It is possible that some of the control group students may "test the waters" of college and leave postsecondary education before receiving a credential or degree. We will test these hypotheses in future analyses of postsecondary completion rates. It should be noted, however, that even though the increase in postsecondary enrollment for early college students is driven in large part by the experience they have while in high school, the students in the control group do not fully catch up even after high school.

Postsecondary Credentials

All of the previous outcomes—college credits, high school graduation, and postsecondary enrollment—are designed to lead to the ultimate goal of increasing postsecondary completion rates. Our data allow us to look at the percentage of students who had postsecondary degrees by six years after entering ninth grade. As Table 3 shows, 30.1% of treatment group students had attained some sort of postsecondary credential compared to 4.2% of the control group. The vast majority of those students had attained an associate degree, with much smaller percentages earning technical credentials and only a few receiving baccalaureate degrees.

Because completion of an associate degree is a goal of the early college program, we might expect higher proportions of students to attain these degrees; however, the extremely low percentage of control students attaining an associate degree, even when given two years after high school, was not anticipated. We will continue to follow these students over time to see if they are able to attain these credentials after an extra year.

Impacts for Subgroups

The results above show overall positive impacts on all of the core outcomes we examined. Yet, the early college model is designed to improve outcomes specifically for students who are underrepresented in college. In this section, we examine the results for the four populations of interest—underrepresented minority students, first-generation college-goers, low-income students, and underprepared students. Following the recommendations of Bloom and Michalopolous (2010), we looked at the impacts for both the targeted population and the corresponding nontargeted population. This allowed us to determine if certain subgroups are benefiting more than others and if gaps between the groups are narrowing or widening. For example, we looked at results for first-generation college-goers and students who were not first generation college-goers. We then statistically compared the differences to determine if any gap between the subgroups was narrowing or widening. Table 4 presents the impact estimates for the core set of outcomes by subgroup, as well as the outcomes for members of the nontargeted population. The table also includes the difference between the two impacts and an indication of whether that differential impact was statistically significant. A positive differential impact indicates that members of the targeted population benefited *more* than members of the nontargeted population, while a negative differential impact indicates that members of the targeted population benefited *less* than members of the nontargeted population.

As Table 4 show, all subgroups showed statistically significant positive impacts on almost all outcomes. For example, all subgroups showed positive impacts on college credit attainment, postsecondary enrollment, and postsecondary credential attainment. For graduation rates, all outcomes were positive although none were statistically significant. In particular, the results show that underprepared students in the treatment group did not graduate at a rate that was appreciably different than the underprepared students in the control group.

When we look at the differential impacts between subgroups (for example, comparing impacts for first generation vs. non-first generation), the patterns become inconsistent. For two of the four outcomes—college credits and postsecondary credential attainment—the nontargeted populations showed higher impacts. There were no significant differential impacts on graduation rates. On the other hand, the impact on postsecondary enrollment was significantly larger for several of the targeted populations than for the nontargeted populations. One possible explanation for this is that postsecondary enrollment is the result of a policy change inherent in the model and is more proximal to the intervention. Improving this outcome thus depends primarily on students adhering to the policies in the early college model. On the other hand, earning college credits and attaining a degree are more distal to the intervention because they involve both compliance with the corresponding policy change and academic performance. Thus, they can be seen as outcomes that are more dependent on students' previous academic preparation.

Limitations

This study has many strengths, including a strong lottery-based experimental design that results in high internal validity. Because this is a prospective study, we are also able to capitalize on a rich set of data that allows us to look at a number of outcomes and that results in

Table 4. Impact estimates, overall and by subgroups.

	N	Adjusted treatment mean	Unadjusted control mean	Impact estimate	Standard error[a]	Difference in subgroup impacts
Panel A: College credits accrued while in high school						
Overall	1,437	21.59	2.8	18.79**	(1.06)	N/A
Underrepresented	494	16.38	1.53	14.85**	(1.42)	−6.06*
Not underrepresented	923	24.22	3.31	20.91**	(1.28)	
First generation	553	18.08	1.56	16.52**	(1.61)	−3.53
Not first generation	841	23.69	3.64	20.05**	(1.13)	
FRPL eligible	680	17.65	1.74	15.91**	(1.45)	−5.59*
FRPL ineligible	699	25.20	3.7	21.50**	(1.33)	
Not prepared for ninth grade	387	10.48	.44	10.04**	(0.94)	−12.40**
Prepared for ninth grade	984	26.11	3.67	22.44**	(1.17)	
Panel B: Five-year graduation rate						
Overall	1,594	85.39	81.37	4.02	(2.90)	
Underrepresented	546	85.55	82.13	3.42	(4.02)	−0.80
Not underrepresented	1,026	84.98	80.76	4.22	(2.87)	
First generation	623	79.29	77.56	1.73	(3.65)	−2.55
Not first generation	915	90.09	85.81	4.28	(2.93)	
FRPL eligible	767	79.56	74.48	5.08	(3.27)	1.81
FRPL ineligible	749	91.63	88.36	3.27	(2.94)	
Not prepared for ninth grade	449	78.60	76.77	1.83	(3.63)	−3.46
Prepared for ninth grade	1,059	89.55	84.26	5.29	(3.58)	
Panel C: Ever enrolled in postsecondary education						
Overall	1,651	89.92	74.28	15.64**	(2.60)	
Underrepresented	568	86.70	72.42	14.28**	(4.50)	−1.92
Not underrepresented	1,061	91.36	75.16	16.20**	(2.37)	
First generation	643	88.83	65.94	22.89**	(3.60)	11.27*
Not first generation	950	91.53	79.91	11.62**	(2.67)	
FRPL eligible	790	87.47	65.14	22.33**	(3.38)	14.36*
FRPL ineligible	773	91.40	83.43	7.97**	(2.58)	
Not prepared for ninth grade	473	85.22	65.61	19.61**	(5.66)	6.35
Prepared for ninth grade	1,088	93.33	80.07	13.26**	(2.36)	
Panel D: % received any postsecondary credential						
Overall	1,651	30.07	4.17	25.90**	(3.34)	
Underrepresented	568	17.27	.6	16.67**	(3.38)	−14.24*
Not underrepresented	1,061	36.69	5.78	30.91**	(3.59)	
First generation	643	22.76	2.64	20.12**	(3.68)	−9.55
Not first generation	950	35.11	5.44	29.67**	(3.77)	
FRPL eligible	790	21.79	1.63	20.16**	(4.90)	−10.95
FRPL ineligible	773	37.66	6.55	31.11**	(3.72)	
Not prepared for ninth grade	473	11.11	1.26	9.85**	(2.10)	−23.44**
Prepared for ninth grade	1,088	38.68	5.39	33.29**	(3.50)	

[a]Cluster-robust standard errors calculated based on the ECHS or regular high school in which students attended the longest are presented in parentheses.
*Statistically significant at $p < .05$.
**Statistically significant at $p < .001$.

very low attrition rates of less than 2% for many outcomes. However, the study does face some limitations, particularly related to questions of generalizability. As noted in the sample section, the schools that participated in the study had to be oversubscribed and had to be willing to use a lottery. This could lead to concerns about whether these schools are representative of the other early colleges in the state. According to data collected by North Carolina New Schools, approximately 87% of the 78 early colleges in North Carolina were oversubscribed such that they accepted 75% or less of their applicant pool. Only two schools in the entire state accepted all of their students, and both were located in small, rural counties. During the period of the study, all early colleges in the state that used a lottery were participating in the study; the remainder of oversubscribed schools used a process that involved rating students on various criteria using a rubric. It is possible that schools that use a lottery may be different than schools that do not on unobservable factors, such as a potential willingness to work with students whom they have not picked and who might be more challenging. A final limitation is that the lottery was conducted on students who applied to the early college; as a result, the impact estimates should be considered as applying only to students who would be interested enough to apply to the early college.

Conclusion

Overall, this study has found that the early college is succeeding in its goal to increase the number of students who are graduating from high school and enrolling in postsecondary education. Although the positive impacts on postsecondary readiness, enrollment, and attainment can likely be primarily attributed to early access to college courses, other components of the model may support students in increasing their enrollment in college. Figure 1 showed the components of the model that are theorized to be connected to increased enrollment and success in college. Elsewhere, we have reported results indicating that early college students experience higher levels of most of these components, including higher expectations, more rigorous and more relevant instruction, and higher levels of academic and affective support (Edmunds et al., 2013). It is possible that these factors, combined with the access to college courses free of charge to the student, contribute to the overall positive outcomes. In addition, the positive impact on four-year enrollment may be highly influenced by the fact that students have already received a significant number of college credits, meaning that they can complete their four-year degrees in less time and at less expense than students who might graduate from a traditional high school.

Despite the positive impacts, some readers may be tempted to discard the findings related to college enrollment while in high school, giving primary weight to those findings that are relevant to postsecondary enrollment after graduation from high school. When considering the results from this study, it is important to recognize that early colleges are actually a new model of schooling. Education is traditionally broken into different stages—pre–K, K–12, and postsecondary—stages that might have some slight crossover or overlap (e.g., Advanced Placement courses) but that are almost always treated as unique and distinct entities. Early colleges do not fit into that traditional compartmentalization; instead, they merge the high school and college experiences such that these two stages happen concurrently. As a result, many students receive their associate degree at the same time as their high school diploma. At this point, we have no reason to believe that receiving an AA or AS at this point in a student's academic career should be seen as any less valuable or important than receiving an AA or AS degree two years after graduating from high school. It could mean, in fact, that students who are seeking a two-year degree as their terminal degree can go into the workforce two years sooner.

When looking at the impacts specifically for the targeted populations, we see that the model has statistically significant, positive impacts for all subgroups for almost all of the outcomes examined. The story is mixed when we look at differential impacts. Our results show that the early college model is narrowing the gap in postsecondary enrollment between targeted subgroups (especially underrepresented minorities and students eligible for free and reduced-price lunch) and their counterparts. However, we observe the opposite pattern for accumulating college credits and for postsecondary credential attainment (particularly non-first generation students who are not eligible for free and reduced-price lunch and academically prepared students, who can be considered as more prepared to take advantage of the early college offerings).

Our positive findings are consistent, both in direction and magnitude, with findings from the AIR retrospective experimental study (Berger et al., 2014; Berger et al., 2013). These two studies together provide an increasing body of evidence that early colleges are a valid and effective intervention worth replicating. Indeed, there are federally supported efforts to replicate the early college both as the small-school model described in this paper and by implementing early college strategies within traditional comprehensive high schools. Evaluations of this work will determine whether the model works in these settings.

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Appendix

Table A1. Descriptive statistics for the outcome measures.

	Treatment			Control		
Outcomes	Unadjusted mean	*SD*	*N*	Unadjusted mean	*SD*	*N*
College credits accrued while in high school						
All students	21.18	20.84	846	2.8	8.34	591
Underrepresented	16.44	18.22	300	1.53	6.43	194
Not underrepresented	23.87	21.63	531	3.31	8.78	392
First generation	17.46	19.62	331	1.56	6.35	222
Not first generation	23.61	21.2	487	3.64	9.43	354
Free/reduced-price lunch eligible	17.33	19.73	405	1.74	6.49	275
Free/reduced-price lunch ineligible	24.77	21.33	400	3.7	9.69	299
Not prepared for ninth grade	10.33	13.55	217	.44	2.36	170
Prepared for ninth grade	25.29	21.67	587	3.67	9.44	397
Percent of students who graduate from high school within five years						
All students	87.06	33.58	905	81.37	38.96	689
Underrepresented	88.01	32.54	322	82.13	38.39	224
Not underrepresented	86.51	34.2	566	80.76	39.47	460
First generation	82.46	38.09	356	77.56	41.8	267
Not first generation	90.44	29.44	516	85.81	34.94	399
Free/reduced-price lunch eligible	83.7	36.98	434	74.48	43.67	333
Free/reduced-price lunch ineligible	92.1	27.01	417	88.36	32.12	332
Not prepared for ninth grade	81.54	38.88	241	76.77	42.33	208
Prepared for ninth grade	90.51	29.33	608	84.26	36.46	451
Percent of students who were ever enrolled in college, by type						
Any type	90.25	29.69	938	74.28	43.74	713
Two-year	87.49	33.11	938	57.46	49.47	713
Four-year	38.23	48.62	938	32.26	46.78	713
Percent of students who were ever enrolled in college, by subgroup						
Underrepresented	88.85	31.52	338	72.42	44.79	230
Not underrepresented	91.4	28.06	583	75.16	43.25	478
First generation	89.23	31.04	369	65.94	47.48	274
Not first generation	92.11	26.99	534	79.91	40.11	416
Free/reduced-price lunch eligible	89.72	30.41	450	65.14	47.72	340
Free/reduced-price lunch ineligible	91.56	27.83	427	83.43	37.24	346
Not prepared for ninth grade	86.28	34.47	260	65.61	47.61	213
Prepared for ninth grade	92.75	25.95	620	80.07	39.99	468
Percent of students enrolled in college courses by grade						
Grade 9	76.94	42.14	938	3.79	19.1	713
Grade 10	72.8	44.52	938	6.05	23.86	713
Grade 11	68.14	46.62	938	12.77	33.4	713
Grade 12	66.63	47.18	938	21.01	40.77	713
Grade 13	68.55	46.46	938	64.53	47.88	713
Grade 14	55.47	49.73	938	59.64	49.1	713
Percent of students who earned a postsecondary credential						
All students	30.13	45.91	938	4.17	20	713
Underrepresented	19.95	40.02	338	0.6	7.76	230
Not underrepresented	35.78	47.98	583	5.78	23.36	478
First generation	22.83	42.03	369	2.64	16.05	274
Not first generation	35.09	47.77	534	5.44	22.71	416
Free/reduced-price lunch eligible	23.24	42.28	450	1.63	12.69	340
Free/reduced-price lunch ineligible	37.34	48.43	427	6.55	24.78	346
Not prepared for ninth grade	11.41	31.86	260	1.26	11.2	213
Prepared for ninth grade	38.25	48.64	620	5.39	22.6	468

Table A2. Sample characteristics, by treatment status, graduation sample.

	Whole sample ($N = 1{,}594$) Mean	Treatment group ($N = 905$) Mean	Control group ($N = 689$) Mean	T-C difference Difference	P value	Effect size
Race/ethnicity						
Black	27.0%	27.4%	26.5%	0.9%	0.71	0.03
Hispanic	8.1%	9.2%	6.6%	2.6%	0.09	0.22
White	59.6%	58.9%	60.5%	−1.6%	0.56	−0.04
Gender						
Male	41.4%	40.3%	43.0%	−2.8%	0.31	−0.07
Socioeconomic background						
First-generation college	38.6%	38.7%	38.4%	0.3%	0.92	0.01
Free/reduced-price lunch eligibility	47.7%	48.7%	46.3%	2.4%	0.39	0.06
Exceptionality						
Disabled/impaired	2.9%	2.3%	3.6%	−1.3%	0.16	−0.28
Gifted	15.5%	14.6%	16.6%	−2.0%	0.32	−0.09
Retained	2.4%	2.1%	2.9%	−0.8%	0.38	−0.19
Eighth-grade achievement						
Math—Z score	0.07	0.04	0.10	−0.06	0.31	−0.06
Reading—Z score	0.05	0.05	0.05	0.00	0.93	0.00
Math—Pass	82.8%	84.4%	80.5%	3.9%	0.23	0.16
Reading—Pass	81.0%	81.6%	80.2%	1.3%	0.88	0.05

Table A3. Sample characteristics, by treatment status, college credits sample.

	Whole sample ($N = 1{,}437$) Mean	Treatment group ($N = 846$) Mean	Control group ($N = 591$) Mean	T-C difference Difference	P value	Effect size
Race/ethnicity						
Black	27.1%	27.3%	26.8%	0.5%	0.83	0.02
Hispanic	7.8%	8.8%	6.4%	2.4%	0.09	0.21
White	60.5%	59.8%	61.6%	−1.8%	0.50	−0.04
Gender						
Male	41.7%	40.6%	43.4%	−2.9%	0.28	−0.07
Socioeconomic background						
First-generation college	40.0%	40.5%	39.2%	1.3%	0.62	0.03
Free/reduced-price lunch eligibility	49.5%	50.4%	48.1%	2.3%	0.39	0.06
Exceptionality						
Disabled/impaired	3.1%	2.5%	4.0%	−1.5%	0.12	−0.29
Gifted	15.3%	14.2%	16.8%	−2.6%	0.18	−0.12
Retained	3.1%	2.6%	4.0%	−1.4%	0.13	−0.28
Eighth-grade achievement						
Math—Z score	0.04	0.01	0.08	−0.07	0.20	−0.07
Reading—Z score	0.03	0.03	0.04	−0.01	0.84	−0.01
Math—Pass	82.1%	83.6%	79.9%	3.7%	0.08	0.15
Reading—Pass	80.9%	81.3%	80.3%	1.0%	0.64	0.04

Table A4. College credits accrued in high school, restricted sample.

	N	Adjusted treatment mean	Unadjusted control mean	Impact estimate	Standard error	Difference in subgroup impacts
Panel A: College credits accrued while in high school						
Overall	1,189	21.84	2.74	18.98**	(1.25)	N/A
Underrepresented	433	17.18	1.55	15.14**	(1.58)	−5.68*
Not underrepresented	736	24.55	3.24	21.26**	(1.40)	
First generation	429	17.90	1.99	15.84**	(1.97)	−4.5
Not first generation	719	23.66	3.25	20.27**	(1.29)	
FRPL eligible	541	17.11	1.84	15.13**	(1.47)	−7.17**
FRPL ineligible	590	25.87	3.43	22.35**	(1.57)	
Not prepared for ninth grade	340	10.92	.39	10.42**	(1.09)	−12.41**
Prepared for ninth grade	795	26.58	3.64	22.94**	(1.38)	

$^{*}p < 0.05$, $^{**}p < 0.001$.