Validity of ACT Composite Score and High School GPA for Predicting Probability of Timely Degree Completion: Examining First-Year College GPA as a Mediator

Riley N. Loria and Edgar I. Sanchez

Introduction

Over the last several decades, pre-college academic indicators like ACT score and high school GPA (HSGPA) have been demonstrated to be useful predictors of success in higher education (Radunzel & Noble, 2012a). Research consistently finds that the use of ACT score as a predictor improves the predictive accuracy of models for various early postsecondary academic outcomes like first-term GPA as well as for longer-term outcomes like degree completion (Kobrin et al., 2008; Mattern & Patterson, 2013; Radunzel & Mattern, 2020). Work from Westrick et al. (2021) finds that both ACT Composite (ACTC) score and HSGPA are highly predictive of first-year college GPA, which is in turn the best predictor of degree persistence at Years 2 and 3. These studies show a strong predictive path between ACTC score and postsecondary persistence. Models including ACTC score in addition to HSGPA perform significantly better at predicting college success than models that do not include ACTC score (Radunzel & Noble, 2012a).

Of course, other predictors are also important for developing a complete picture of student capabilities. For example, a meta-analysis from Perera and DiGiacomo (2013) found that traits such as emotional intelligence can predict academic performance such that high trait levels consistently predict better academic performance. Other work has found that behavioral skills such as motivation and self-regulation, as well as antecedents to behavioral skills like conscientiousness and emotional regulation, are valuable predictors of later academic performance, with better behavioral competencies predicting higher rates of academic success (Camara et al., 2015; Caspi & Shiner, 2006; Poropat, 2009; Robbins et al., 2006). Regardless of the utility of other predictors, ACT scores have consistently emerged as a valuable predictor of college success. ACTC scores are not intended to replace noncognitive predictors of success. Instead, these scores reflect the achievement levels that would make someone successful in college.

HSGPA is one of the other most predictive and commonly used metrics for predicting college success. Unlike ACTC score, it is a multidimensional measure of achievement that is also affected by various noncognitive factors. For example, in one study, a model of intrinsic motivation and related subordinate factors (e.g., interest in school, enjoyment of class) accounted for around 33% of the variance in HSGPA (Froiland & Worrell, 2016). Another study from Steedle and Way (2024) found that various noncognitive factors (including social emotional skills; demographic categories; and characteristics that vary between high schools, such as demographic composition) are highly predictive of HSGPA above and beyond cognitive factors, including ACT scores. While findings like these mean that HSGPA may account for more variance than ACTC score in predictive models (Allensworth and Clark, 2020), it is difficult to ascertain precisely which latent traits are represented by HSGPA.

Precision is essential in developing fair and consistent models of success. Recent work in the wake of the COVID-19 pandemic (Sanchez, 2024) indicates that HSGPA was substantially more subject to shifts in predictive validity than ACTC score between 2017 and 2021, which further highlights the importance of precision and consistency in interpretation. This study also found that using both HSGPA and ACTC score together provided better predictive accuracy than using either alone. Other work (Sawyer, 2010) found that while HSGPA is more useful in minimally selective admissions decisions, ACT and SAT scores were significantly more useful for highly selective institutions. Both of these studies demonstrate the compensatory nature of having both types of achievement measures. Considering principles of incremental validity (Smith et al., 2003), which generally suggest developing measures for a single latent construct to maintain precision, ACTC score is essential as a predictive tool to narrow in on cognitive ability as a latent variable. Further exploring mechanisms by which ACT scores can effectively predict college degree completion allows education researchers to better address questions raised by the increasing scrutiny and calls for transparency in admissions decisions (Adnett et al., 2011).

As a result of some of this scrutiny, in recent years, particularly after the onset of COVID-19, a rising number of colleges have made ACT and SAT scores optional for their student applications (Schultz & Backstrom, 2021). Some researchers and educators, such as Koljatic et al. (2021), have questioned the utility of metrics like the ACT in predicting student success and reducing admissions bias. Despite concerns around biases in high stakes assessments, many argue and find evidence that standardized assessments like the ACT are less susceptible to bias and group differences than things like HSGPA or student interviews (Alvero et al., 2021; Briggs, 2021; Otugo et al., 2021; Steedle & Way, 2024). There is little evidence suggesting differential item functioning by groups for standardized tests like the ACT and SAT (Santelices & Wilson, 2012). While colleges may feel as though heavily weighting things like personal essays or letters of recommendation will make their choices less biased, these metrics are substantially more subject to human biases than test scores (Murphy et al., 2009; Woo et al., 2023). In fact, some work suggests that group differences in scores caused by systemic issues like underfunding of schools can be more effectively corrected and adjusted for in admissions decisions when a standardized measure is used (Woo et al., 2023). Measures like the ACT remain an essential tool for fairness and reducing bias and human error in admissions decisions. Research into the incremental validity and efficacy of assessments like the ACT helps improve the validity of postsecondary models predicting student success.

In the past, much of the research on the efficacy of pre-college academic achievement measures has examined their relationship with first-year GPA (FYGPA) as a college success outcome (e.g., Allen & Radunzel, 2017). Prior work demonstrates that ACT scores are predictive of FYGPA (Huh & Huang, 2016). However, as institutions of higher education have faced increased expectations of accountability for the performance of their students over time, FYGPA on its own may be considered an insufficient measure of academic success in college overall.

In the current educational climate, there is more pressure for postsecondary institutions to better understand and predict their students' long-term academic achievement and offer appropriate help to those at risk of attrition or failure to graduate. As such, recent work has expanded to focus more on longer-term college success measures, such as cumulative GPA and on-time degree completion, and effective predictors of these outcomes. For example, both ACTC score and HSGPA predict cumulative college GPA at graduation and predict the probability of degree completion within 6 years at 4-year institutions and within 4 years at 2-year institutions (ACT, 2013; Radunzel and Noble, 2012a). Other work finds that meeting the ACT College Readiness Benchmarks increases the likelihood that someone will persist in college and complete a degree on time (Radunzel & Noble, 2012b). By extending their work beyond early college success, researchers can better examine the predictive validity of the ACT in long-term academic and even career success.

Despite evidence for ACT scores as meaningful predictors of both FYGPA and degree completion, little work has examined the pathway by which FYGPA might partially mediate the relationship between degree completion and pre-college academic predictors like ACTC score. Though some models have included FYGPA in their prediction of long-term college success, the pathway between these variables is underexplored. Understanding how these factors build on each other to yield distinct outcomes is essential for improving the predictive power of a model. Poor performance early in college, such as a low FYGPA, may be indicative of poor preparation and a lack of essential foundational knowledge, and it may lead to things like loss of scholarship funding or a decreased likelihood of moving on to more advanced coursework. These things can compound and make a person less likely to complete their degree (Schreiner et al., 2020).

In this study, we extend prior research, which has largely focused on assessing the ACT score's value as a predictor of early college outcomes like FYGPA, to examine the ability of the ACTC score to predict later college outcomes like degree completion at Years 4 and 6. We examine a plausible predictive chain in which we expect HSGPA and ACTC score to predict FYGPA, which will in turn predict graduation likelihood by Years 4 and 6. By examining this process, we aim to bolster the ability of postsecondary schools to predict graduation success.

Conducting a path analysis to better understand the predictive validity of ACT scores for degree completion as they relate to early performance in postsecondary school can help researchers better understand how early performance relates to long-term performance. A path analysis uses structural equation modeling to unpack the direct and indirect relationships between predictors and outcomes. Path analysis can help determine whether the effect of ACTC score and HSGPA together on the odds of degree completion can be partly explained and mediated by these metrics' relationship with FYGPA. By understanding this process, both high school and higher education professionals can better identify at-risk students. To better understand the path between HSGPA, ACTC score, FYGPA, and degree completion outcomes, we have two main research questions.

1. Does FYGPA mediate the effect of HSGPA and ACTC score on the probability that a student will complete a bachelor's degree by Year 4 or 6?

2. What is the role of ACTC score and HSGPA together in predicting the probability of degree completion by Years 4 and 6 after FYGPA is accounted for?

Methods

Sample Characteristics

Our sample consisted of students from one U.S. state who entered a 4-year public postsecondary school in the fall of 2017. This includes a total of 32 institutions. Because of an in-school testing program in this state, nearly all public high school graduates in the state have taken the ACT. Only students with valid ACTC scores, HSGPA, FYGPA, demographic characteristics, and records of degree attainment status by Years 4 and 6 were included in the sample.

Measures

ACT Composite Score

ACT Composite score was obtained from official test records. If a student had multiple scores on record, their most recent score prior to graduation was used. These scores were from either the state's in-school testing administration or a national test administration.

Cumulative High School GPA (*HSGPA*)

During ACT registration, students reported their grades, on a 0.0–4.0 scale, for as many as 23 courses in core areas such as math, English, science, and social studies. We averaged each student's grades to find their HSGPA. Students with a missing HSGPA were excluded from the analysis. The number of self-reported grades among the possible 23 courses varied for each student. Prior work supports the use of self-reported HSGPA as an accurate measure of high school achievement; self-reported grades are highly correlated with transcript GPA (Sanchez & Buddin, 2016).

First-Year College GPA (*FYGPA*)

FYGPA was attained directly from official postsecondary school transcripts.

Bachelor's Degree Completion

Bachelor's degree completion was attained directly from official postsecondary school transcripts. Degree completion was measured as a binary variable at two time points. Those who had successfully obtained their degrees within 4 years of beginning postsecondary school were assigned 1 for the binary Year 4 outcome variable, and those who had not obtained their degrees were assigned 0. Similarly, students who had completed their degrees by Year 6 were assigned 1, and those who had not were assigned 0.

Demographic Variables

Three demographic variables were collected at the time of ACT test registration: gender, race/ethnicity, and family income. Gender was reported by students as either male or female (the option "another gender" is now included for ACT demographic data but was not available at the time this cohort reported their data). Students selected their racial/ethnic identity from the following options: Asian, Black, Hispanic, American Indian/Alaska Native, Native Hawaiian/Pacific Islander, White, two or more races, or prefer not to respond. All demographic information is provided in descriptive tables below. The American Indian/Alaska Native, Native Hawaiian/Pacific Islander, and two or more races categories were combined for analysis due to low overall group numbers. Self-reported family income was in four groups: below $36,000, $36,000–$60,000, $60,000–$100,000, and above $100,000. We also include a missing response category for income due to the large percentage of missing income data (12%).

Data and Analysis

Data in this project were clustered, with students nested within their starting institution (i.e., the first 4-year postsecondary institution they attended). Across the 19,515 students, we include a total of 30 institutions/clusters. The number of students per institution varied from 98 to 4,532. Due to the unique characteristics of each postsecondary institution (e.g., selectivity, level of funding available, and student population), we expected these groups to account for a meaningful portion of the variance in degree completion by Years 4 and 6. Indeed, the intraclass correlation coefficient was relatively high at 0.14 for the likelihood of graduation by Year 4 and 0.16 for graduation by Year 6. The clustering of observations was accounted for in all models through the use of cluster-robust standard errors for the path analysis or through hierarchical logistic models.

We used standardized HSGPA, ACTC score, and FYGPA in all our models, and we report four models in this paper. First, we used a structural equation model to test whether the effect of HSGPA and ACTC score together on a student's probability of completing a degree by Year 4 is mediated by FYGPA. We used the clustering feature in the Laavan package in R to account for nesting within institution. We also generated a second model with the same predictors and structure but with a student's probability of completing a degree by Year 6 as the outcome, again clustering by institution.

We also report two hierarchical logistic models for odds of degree completion by Years 4 and 6. These models included HSGPA, ACTC score, the interaction of HSGPA and ACTC score, FYGPA, family income level, race/ethnicity, and gender as fixed effects. Each model used random intercepts for institution. Initially, both models also included random slopes for both HSGPA and ACTC score. However, including random slopes for both caused a singular model fit in the model for graduation likelihood at Year 4. As such, a random slope for ACTC score was dropped for this model to avoid overfitting; we also dropped the random slope for ACTC score in the Year 6 model for consistency between the two. The models that used a random slope for HSGPA were compared to models that used only a random intercept and were determined to have better fit.

We examined several model fit measures for the hierarchical model and report them in the results section. We assessed both Akaike inference criteria and Bayesian inference criteria. Additionally, we report both marginal R^2 (the variance in the outcome explained by fixed effects) and conditional R^2 (the variance explained by the entire model). We used Nakagawa's method of calculating these values (Nakagawa & Schielzeth, 2013). We also report the percent reduction in residual variance for each model as compared to the null model. Here, the null model is a model including only random intercepts for institutions.

Results

Descriptive Statistics

Our sample for this project contained slightly more female students than male students (55.5% and 44.2%, respectively). The largest family income group in the sample was students from families making less than $36,000 a year, with 26.1% of students in that category. Around two thirds of the sample (66.1%) was White. Full demographic characteristics, including gender, race/ethnicity, and family income, are displayed in Table 1.

Of the 19,613 students in our sample, 31.4% (6,154 individuals) completed their degrees within 4 years of beginning their postsecondary education (see Table 1). By Year 6, 38.3% of the sample (7,515 individuals) had completed their degrees. Compared to the 2017 ACT-tested high school graduating class, the sample consisted of slightly more female students, slightly fewer Hispanic students, and slightly more White students, as well as notably fewer students who did not provide family income.

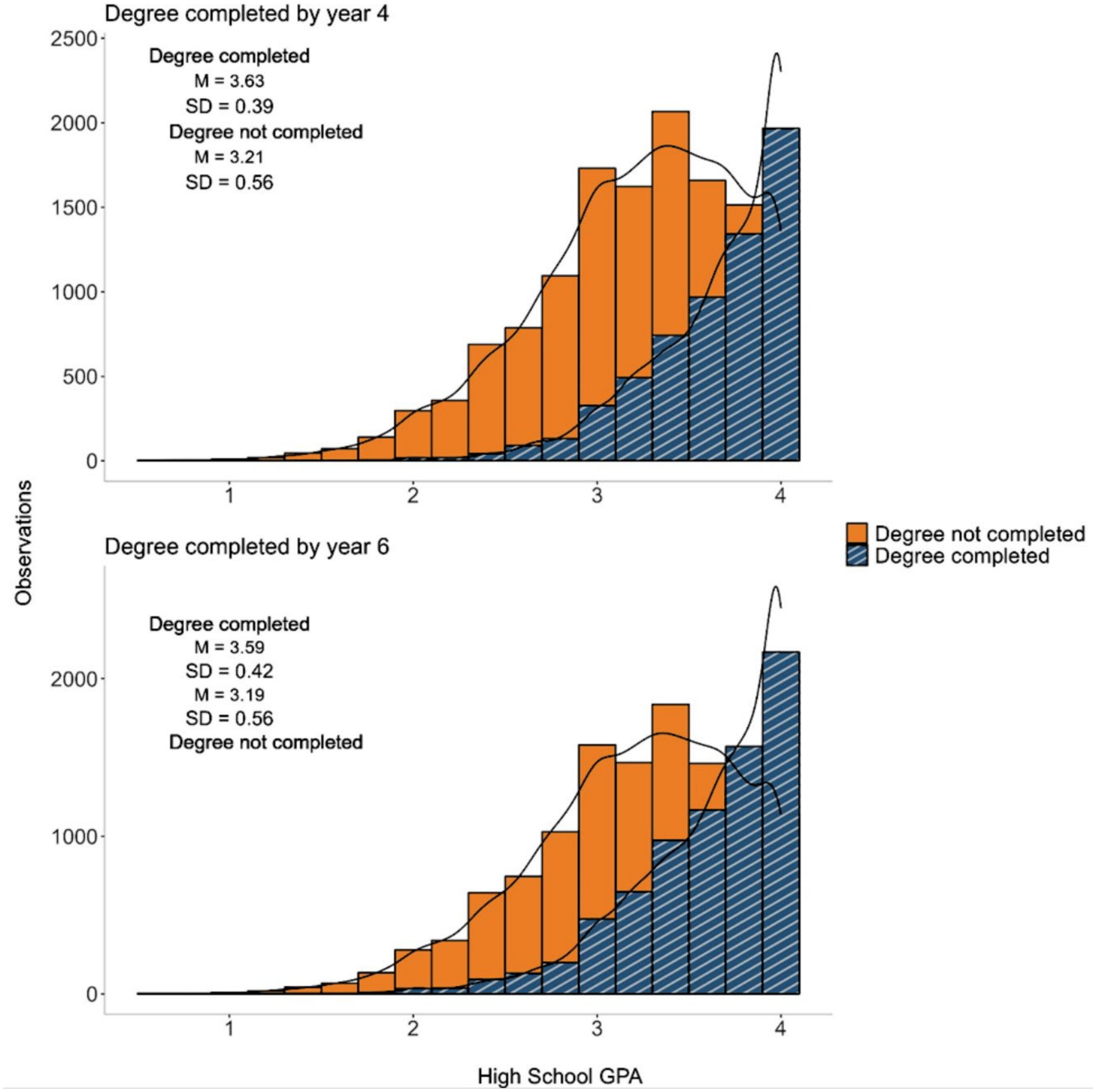
Table 1. Sample Characteristics

Student characteristics		Sample frequency (percentage)	2017 graduating class frequency (percentage)
N		19,613	2,030,038
Degree complete by Year 4		6,153 (31.4)	—
Degree complete by Year 6		7,515 (38.3)	—
Gender	Female	10,884 (55.5)	1,047,170 (51.6)
	Male	8,663 (44.2)	939,730 (46.3)
	Missing	66 (0.3)	43,138 (2.1)
Race/ethnicity	African American	2,598 (13.2)	256,756 (12.6)
	American Indian/Alaska Native	121 (0.6)	16,135 (0.8)
	Asian	330 (1.7)	96,097 (4.7)
	Native Hawaiian/Pacific Islander	19 (0.1)	6,503 (0.3)
	Hispanic	1,956 (10.0)	347,906 (17.1)
	Prefer not to respond/missing	754 (3.8)	158,083 (7.8)
	Two or more races	863 (4.4)	86,119 (4.2)
	White	12,972 (66.1)	1,062,439 (52.3)
Family income	Less than $36K	5,122 (26.1)	426,337 (21.0)
	$36K–$60K	3,784 (19.3)	289,021 (14.2)
	$60K–$100K	4,064 (20.7)	318,381 (15.7)
	More than $100K	4,281 (21.8)	385,166 (19.0)
	Missing	2,362 (12.0)	611,133 (30.1)

Note. Percentages may not sum to 100% due to rounding.

The average HSGPA in this sample was 3.34 (*SD* = 0.55) on a 0.0–4.0 scale. The average ACTC score was 21.56 (*SD* = 4.79) on a 1–36 scale, and the average FYGPA was 2.68 (*SD* = 1.10) on a 0.0–4.0 scale. Further breaking down these scores, we see that the average HSGPA of students who completed their degrees by Year 4 was higher than the average HSGPA of those who completed their degrees by Year 6. The HSGPA distributions of students who completed and did not complete their degrees are shown in Figure 1. Of note is the fact that HSGPA is negatively skewed, with the highest GPA density above 3.0 in both groups. This is likely affected by student attrition, as this sample includes only those who successfully completed high school and at minimum enrolled in a postsecondary institution.

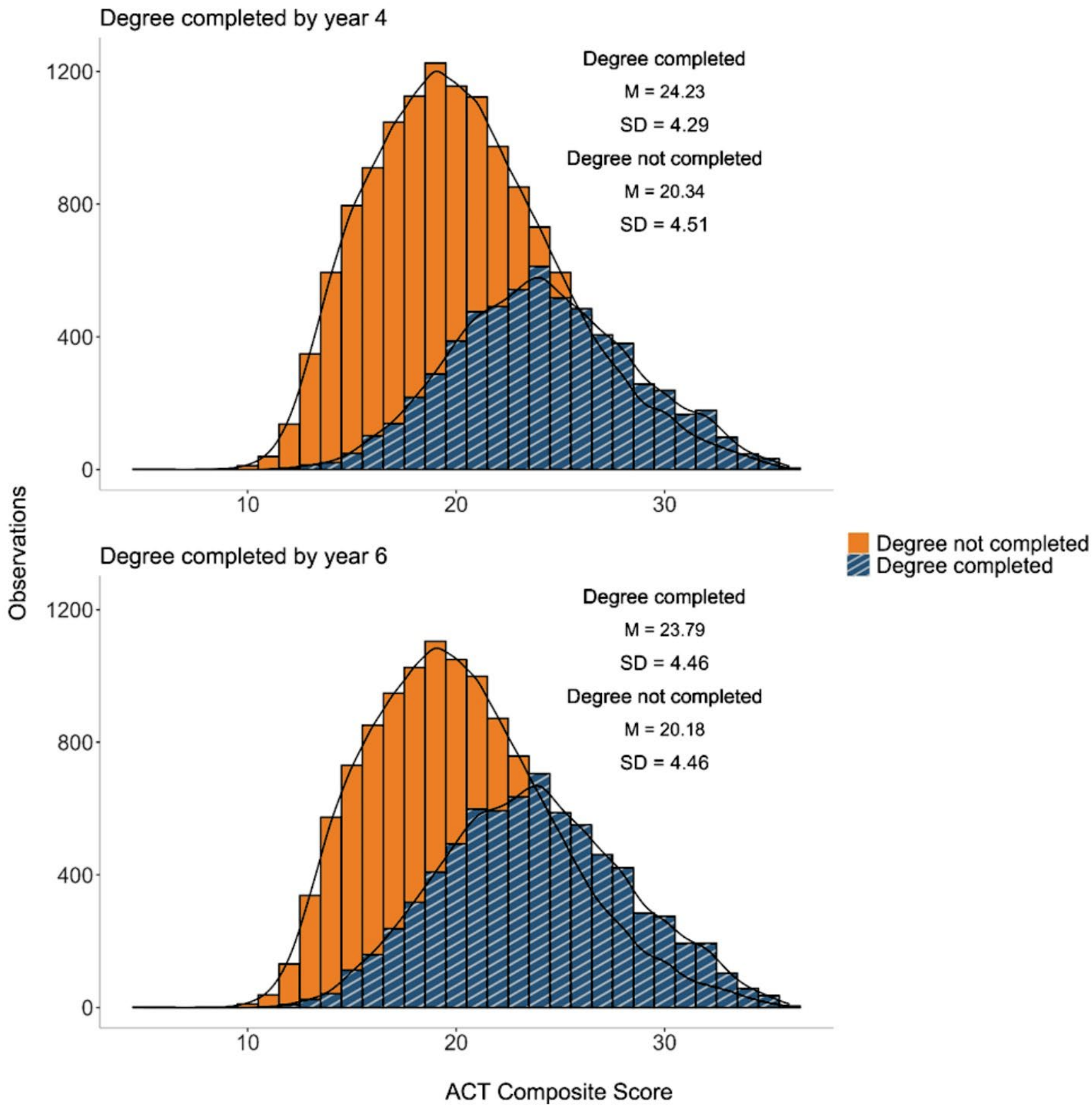
Figure 1. HSGPA of Students Who Did and Did Not Complete Degrees by Years 4 and 6



Note. At the upper end of the HSGPA scale, the orange bars are covered by the blue bars. The trend in the number of observations can be seen by the decrease in the respective density function.

The average ACTC score of those who completed their degrees by Year 4 was also higher than the average ACTC score of those who did not. The same was true for degree completion by Year 6. The distributions are shown in Figure 2. The distributions are relatively normal, though slightly negatively skewed.

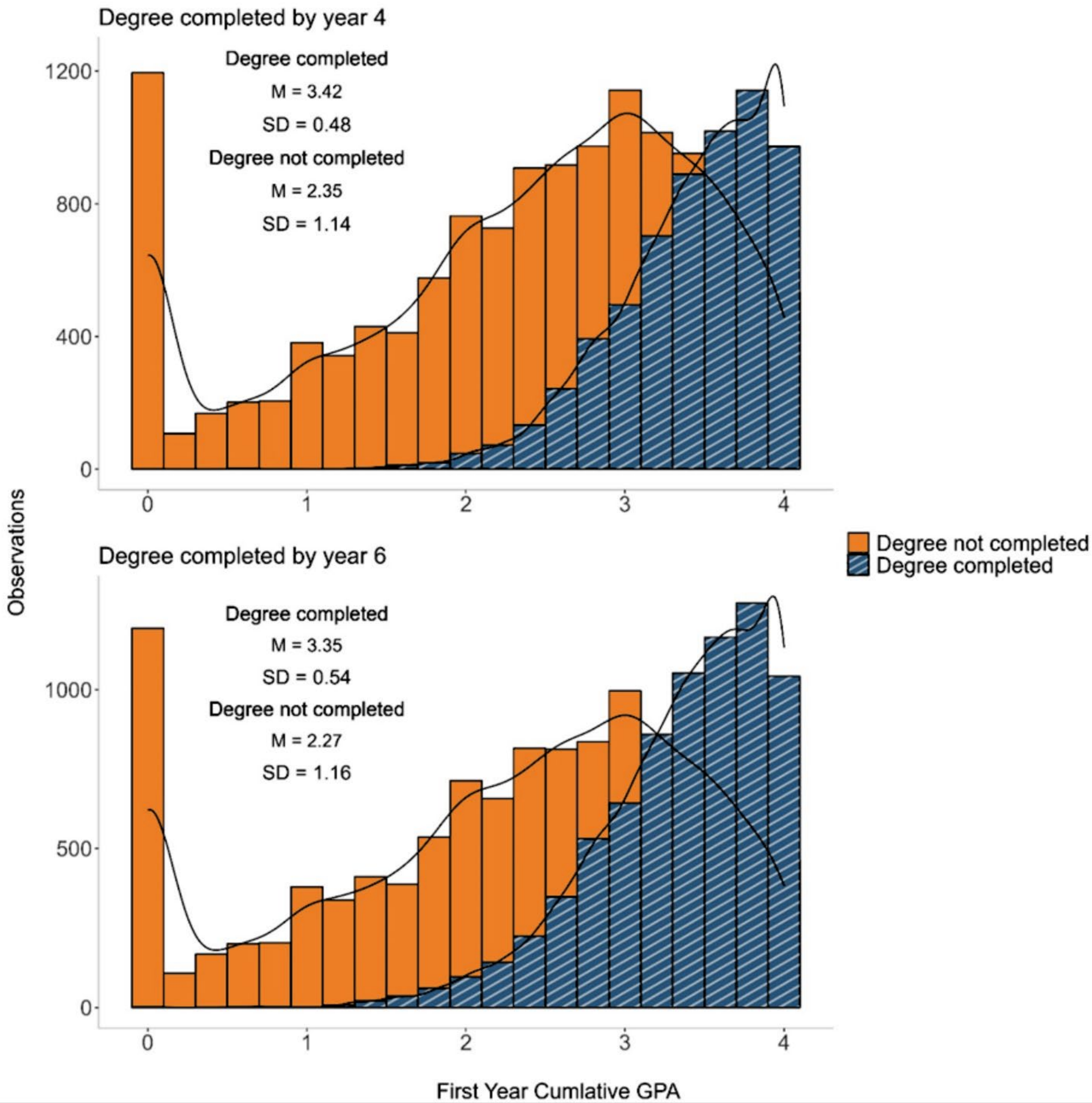
Figure 2. ACTC Score of Students Who Did and Did Not Complete Degrees by Years 4 and 6



Note. At the upper end of the ACT Composite score scale, the orange bars are covered by the blue bars. The trend in the number of observations can be seen by the decrease in the respective density function.

Lastly, for both Year 4 and Year 6, the average FYGPA of those who completed their degrees was higher than the average of those who did not. The distributions are shown in Figure 3. FYGPA is somewhat unusually distributed, with a slight general skew toward higher GPAs but with a large number of students earning a 0.0 GPA. The high density of zeros likely represents students who left school before completing the first year. These zero FYGPAs almost entirely come from students who did not complete a degree by Year 4 or 6, with only three students who obtained zero FYGPAs having completed a degree by Year 6.

Figure 3. FYGPA of Students Who Did and Did Not Complete Degrees by Years 4 and 6



Note. At the upper end of the FYGPA scale, the orange bars are covered by the blue bars. The trend in the number of observations can be seen by the decrease in the respective density function.

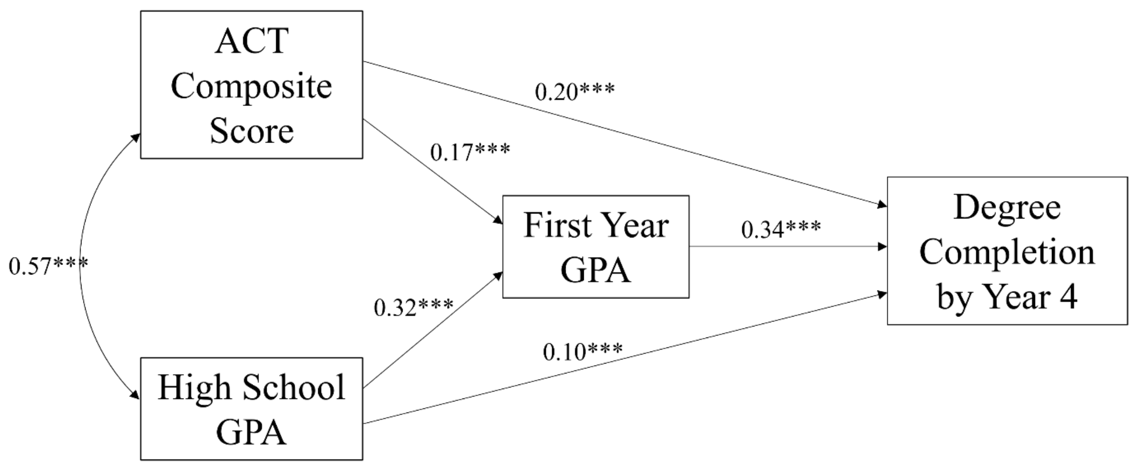
Does FYGPA mediate the effect of HSGPA and ACTC score on the probability that a student will complete a degree?

To answer the first research question, we used path analysis to assess the role of FYGPA as a possible mediator for the effect of HSGPA and ACTC score on the probability of completing a bachelor's degree by Year 4 or 6. We used two structural equation models to conduct this mediation analysis, one for the probability of degree completion by Year 4 and one for the probability of degree completion by Year 6. For the sake of clarity and parsimony, we did not include demographic predictors of degree completion in these initial path models; we instead examined these additional predictors later in hierarchical logistic models. However, the path models did include clustering by institution to account for more random error. Figures 4 and 5 show all significant paths and covariance included in the model.

Model fit was excellent for both path models. Both had chi-squared values of less than 0.001 (and *p*-values of <0.001), both had RMSEA (root mean square error of approximation) values of less than .001, and both had CFI (comparative fit index) and GFI (goodness-of-fit index) values of 1.00, all indicating good parameter fit.

Path Model 1 examines degree completion by Year 4 (Figure 4). We report standardized beta estimates. The path analysis indicates that both HSGPA ($\beta = .32$, $p < .001$) and ACTC score ($\beta = .17$, $p < .001$) are significant predictors of FYGPA. These predictors also significantly covaried ($\beta = .57$, $p < .001$). ACTC score ($\beta = .20$, $p < .001$) and HSGPA ($\beta = .10$, $p < .001$) were also both direct predictors of the probability of degree completion by Year 4. FYGPA was also a significant predictor of degree completion by Year 4 ($\beta = .34$, $p < .001$). Finally, the indirect relationship between HSGPA and degree completion in 4 years mediated via FYGPA ($\beta = .11$, $p < .001$) and the indirect relationship between ACTC score and degree completion in 4 years mediated via FYGPA ($\beta = .06$, $p < .001$) were also significant. These relationships suggest that FYGPA does in fact act as a mediator for the relationship between the probability of degree completion by Year 4 and ACTC score and HSGPA together.

Figure 4. Path Analysis of Effect of ACTC Score and HSGPA on Probability of Degree Completion by Year 4 With FYGPA as a Mediator (Path Model 1)

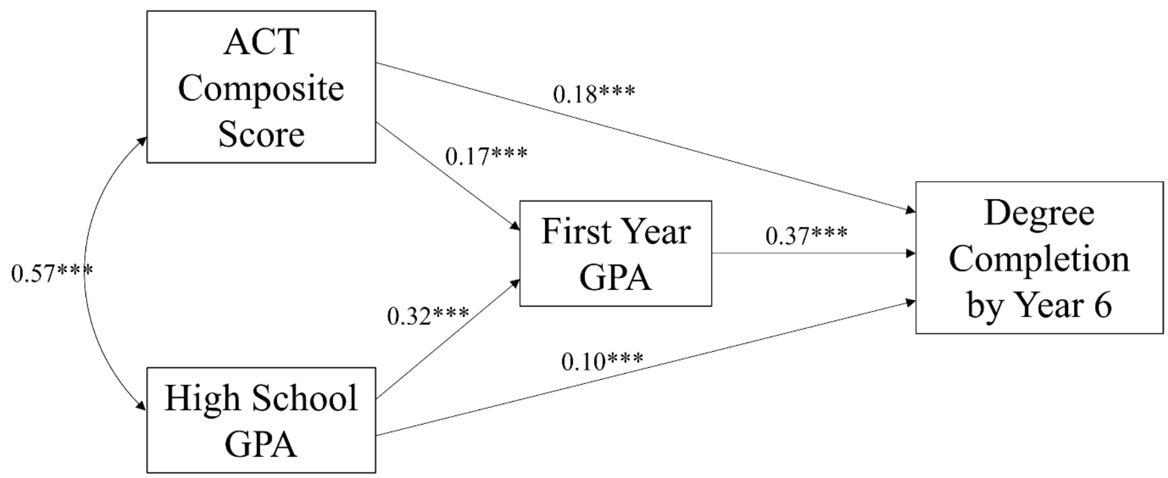


Note. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Path Model 2 examines degree completion by Year 6 (Figure 5). Outcomes are similar to those at Year 4. The path for ACTC score and HSGPA with FYGPA is defined in the same way as it was in Path Model 1, yielding the same beta estimates, indicating that both HSGPA ($\beta = .32$, $p < .001$) and ACTC score ($\beta = .17$, $p < .001$) are significant predictors of FYGPA. HSGPA ($\beta = .10$, $p < .001$) and ACTC score ($\beta = .18$, $p < .001$) were again both direct predictors of the probability of degree completion by Year 6. FYGPA was also a significant predictor of degree completion by Year 6 ($\beta = .37$, $p < .001$). Finally, the indirect relationship between HSGPA and degree completion in 6 years mediated via FYGPA ($\beta = .12$, $p < .001$) and the indirect relationship between ACTC score and degree completion in 6 years mediated via FYGPA ($\beta = .06$, $p < .001$) were also significant. These relationships suggest that FYGPA does in fact act as a mediator for the relationship between the probability of degree completion by Year 6 and ACTC and HSGPA together.

Notably, although the predictive relationship between HSGPA and FYGPA was stronger than the relationship between ACTC score and FYGPA in both models, ACTC score had a stronger direct effect on the probability of degree completion in the two models.

Figure 5. Path Analysis of Effect of ACTC Score and HSGPA on Probability of Degree Completion by Year 6 With FYGPA as a Mediator (Path Model 2)



Note. *p < 0.1; **p < 0.05; ***p < 0.01

Now that we have established support for FYGPA's role as a mediator for the effects of HSGPA and ACTC score together on the probability of degree completion by Years 4 and 6, we further explore these relationships in more complex hierarchical models.

What is the role of ACTC score and HSGPA together in predicting the probability of degree completion by Years 4 and 6 after FYGPA is accounted for?

We modeled two hierarchical logistic regressions to further examine the role of ACTC score and HSGPA in predicting the probability of degree completion by Years 4 and 6. These models also included several demographic predictors: ACTC score, HSGPA, gender (a categorical variable), race/ethnicity (a categorical variable), and family income (a categorical variable). These two models also included random slopes for HSGPA and random intercepts for institutions. Though initial models also included random slopes for ACTC score by institution, this resulted in model overfit in the Year 4 model. Therefore, random slopes for ACTC score by first-year institution were dropped in both models to avoid singularity and maintain consistency. All models included clustering by starting postsecondary institution.

In the model for degree completion by Year 4, ACTC score (OR = 1.13), HSGPA (OR = 1.19), the interaction between ACTC score and HSGPA (OR = 0.91), and FYGPA (OR = 6.31) were all significant predictors of degree completion by Year 4 (see Table 2). FYGPA was by a wide margin the strongest predictor of degree completion by Year 4: For each standard deviation increase of FYGPA, the odds of completing a bachelor's degree by Year 4 increased 6.31 times. We also find a significant interaction between HSGPA and ACTC score such that ACTC score is more highly predictive of degree completion at Year 4 as HSGPA increases. Family income was also a positive predictor of the probability of degree completion by Year 4. Those from families making more than \$36,000 a year were substantially more likely to complete degrees by Year 4 than those from families making less than \$36,000 a year. The biggest odds ratio was for the greater-than-\$100,000 income bracket, with an odds ratio of 1.63, making this group 1.63 times more likely to complete their degrees by Year 4 than students from families making less than \$36,000. Women were also slightly more likely than men to complete their degrees by Year 4 (OR = 1.08, p = 0.074). Finally, those in the American Indian/Alaska Native, Native Hawaiian/Pacific Islander, or two or more races group were slightly less likely than White students to complete their degrees by Year 4.

Table 2. Odds Ratios for Hierarchical Logistic Regression Models of Degree Completion by Years 4 and 6

Predictor	Graduation in 4 years			Graduation in 6 years		
	Odds ratio	95% CI	*p*-value	Odds ratio	95% CI	*p*-value
(Intercept)	0.05	0.03–0.08	<0.001	0.11	0.07–0.17	<0.001
ACTC	1.13	1.06–1.20	<0.001	1.08	1.02–1.14	0.007
HSGPA	1.19	1.05–1.35	0.007	1.15	1.03–1.29	0.016
FYGPA	6.31	5.79–6.88	<0.001	5.03	4.68–5.41	<0.001
Gender: female	1.08	0.99–1.18	0.073	0.98	0.90–1.06	0.539
Gender: missing	0.47	0.15–1.50	0.201	1.21	0.50–2.91	0.669
Race: Black	0.89	0.76–1.04	0.127	1.05	0.92–1.21	0.453
Race: two or more races/Native Hawaiian/Pacific Islander/American Indian/Alaska Native	0.78	0.65–0.95	0.012	0.9	0.75–1.07	0.233
Race: Asian	0.91	0.68–1.20	0.494	0.94	0.72–1.24	0.67
Race: Hispanic	0.88	0.75–1.02	0.088	0.98	0.85–1.12	0.744
Race: prefer not to respond/missing	0.65	0.51–0.83	<0.001	0.61	0.49–0.76	<0.001
Family income: \$36K–\$60K	1.24	1.09–1.42	0.001	1.17	1.04–1.32	0.008
Family income: \$60K–\$100K	1.25	1.10–1.42	0.001	1.19	1.06–1.34	0.004
Family income: >\$100K	1.63	1.43–1.86	<0.001	1.59	1.41–1.79	<0.001
Family income: missing	1.25	1.07–1.46	0.004	1.23	1.07–1.41	0.004
ACTC × HSGPA	0.91	0.86–0.97	0.003	0.97	0.92–1.02	0.24
σ^2	3.29	—	—	3.29	—	—
τ_{00}	1.62	—	—	1.29	—	—
τ_{11}	0.03	—	—	0.04	—	—
ρ_{01}	0.19	—	—	0.07	—	—
ICC	0.33	—	—	0.29	—	—
N	30	—	—	30	—	—
Observations	19,613	—	—	19,613	—	—
Marginal R^2 / conditional R^2	0.458/0.639	—	—	0.399/0.572	—	—
AIC	14886.47	—	—	16549.3	—	—
log-likelihood	−7424.23	—	—	−8255.65	—	—

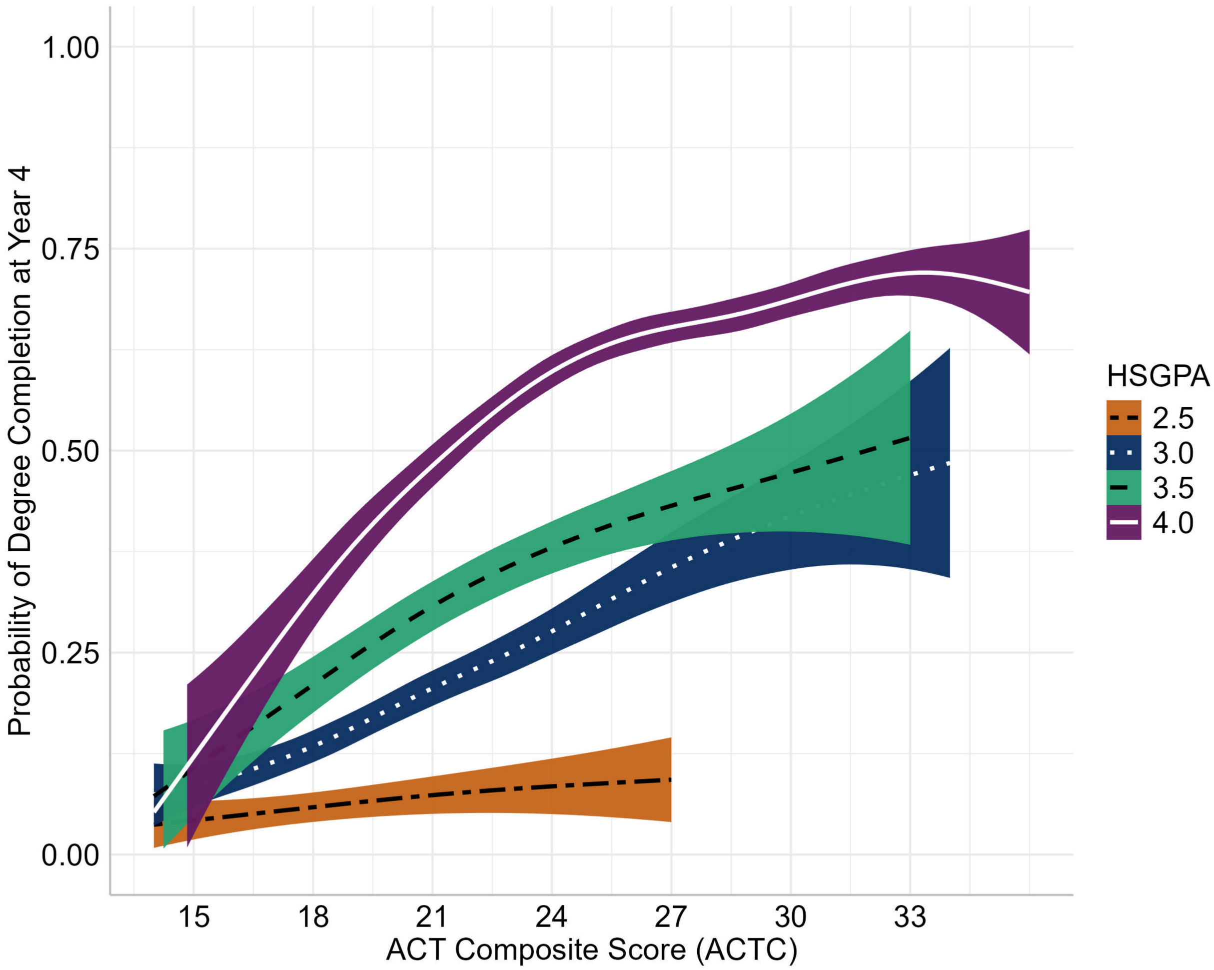
Note: **p* < 0.1; ***p* < 0.05; ****p* < 0.01. The reference group for race/ethnicity comparison is White students, the reference group for gender comparison is male students, and the reference group for income level comparison is less than \$36,000 yearly income.

Results of the model for degree completion by Year 6 were similar to those of the Year 4 model, though predictor odds ratios were overall slightly smaller for the Year 6 model. ACTC score (OR = 1.08), HSGPA (OR = 1.15), and FYGPA (OR = 5.03) were all significant predictors of degree completion by Year 6. In this model, however, the interaction between ACTC score and HSGPA was no longer significant (OR = 0.97, $p = 0.244$). Though slightly weaker than in Year 4, FYGPA was still the strongest predictor of degree completion by Year 6, with an OR of 5.03, meaning for each standard deviation increase in FYGPA, the odds of degree completion by Year 6 were about 5 times as great when other variables in the model were held constant. There were no significant differences by gender and most races/ethnicities for this model. Students who preferred not to respond or did not provide race/ethnicity information were less likely than White students to complete their degrees by Year 6. Higher family income groups again predicted greater odds of degree completion, such that those with families making more than $36,000 a year were more likely to complete their degrees by Year 6 than those with families making less than $36,000. The odds ratio for students from families making more than $100,000 was the largest, with this group being 1.59 times more likely than students from families with less than $36,000 per year to finish their degrees by Year 6.

Across both models, model fit was good, and these models explained a large proportion of the variance in the probability of degree completion by Years 4 and 6. The model for graduation by Year 4 has a marginal R^2 value of 0.46 and a conditional R^2 value of 0.64. These values indicate that the fixed effects in the model account for 46% of the observed variance in Year 4 graduation outcomes, while the total model (fixed and random effects) accounts for 64% of the variance. The model for graduation by Year 6 has a marginal R^2 value of 0.40 and a conditional R^2 value of 0.57. These values indicate that the fixed effects in the model account for 40% of the observed variance in Year 6 graduation outcomes, while the total model (fixed and random effects) accounts for 57% of the variance. Both models account for more than half the observed variance in degree completion, with the Year 4 model accounting for slightly more variance. Including demographic variables that have previously been connected to college success, we find that FYGPA is the strongest predictor of degree completion at both time points.

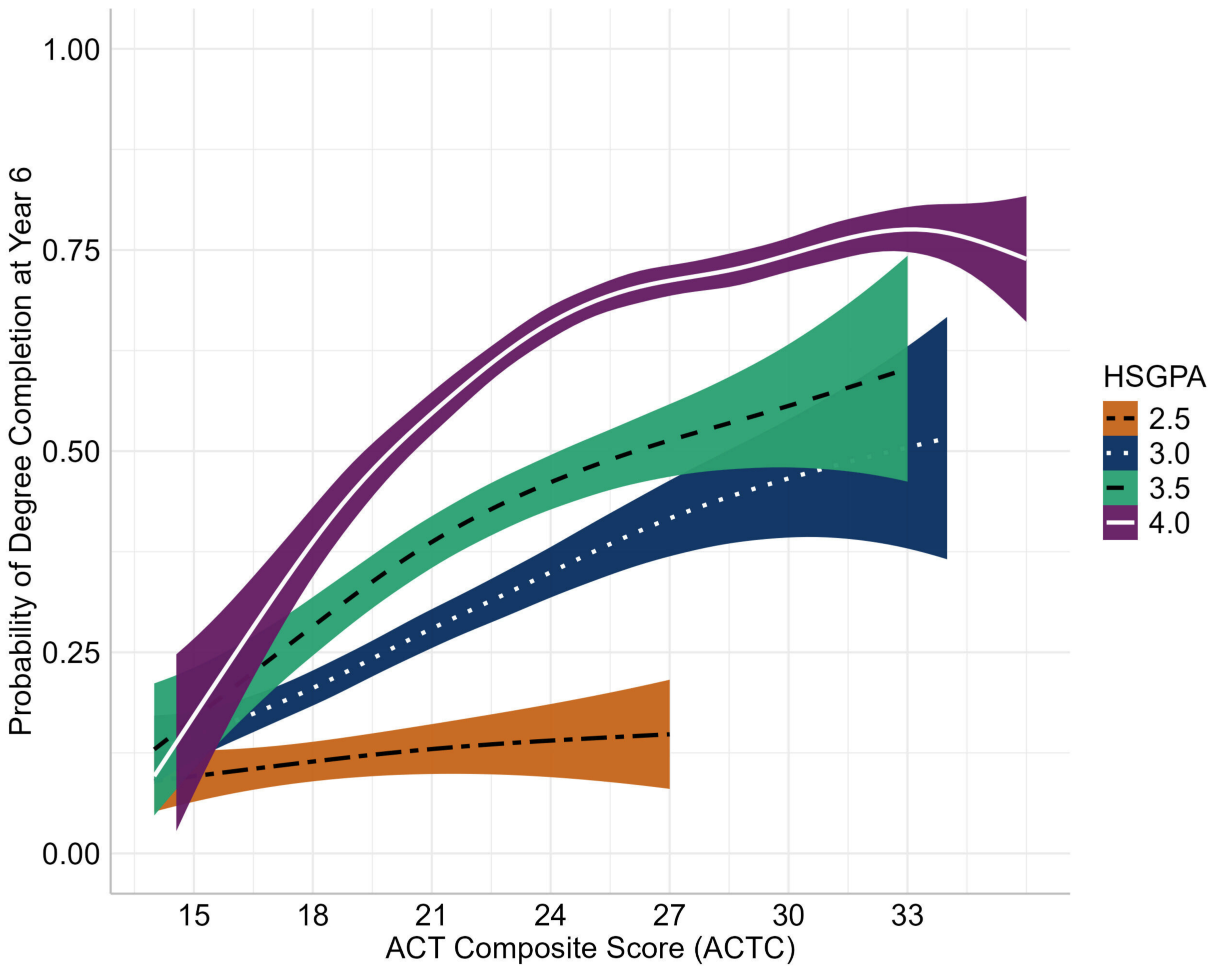
Predicted model outcomes are shown in Figures 6 and 7. These model graphs demonstrate the predicted relationship between the probability of graduating by Year 4 or 6 and HSGPA and ACTC score. In both figures, we see that as ACTC score increases, the predicted probability of graduating by Year 4 or 6 increases. For the purpose of graphing these models and depicting the relationship between HSGPA and ACTC score, we display only selected values for HSGPA. Figures 8 and 9 also show that in general, as HSGPA increases, so does the predicted probability of graduating by Year 4 or 6. It is also worth noting that the interaction between HSGPA and ACTC scores in the Year 4 model is also demonstrated by Figure 6. Though the interaction appears similar in Figure 7 for the Year 6 model, the interaction falls below significance after demographic predictors are included.

Figure 6. Hierarchical Logistic Regression Model Predicting Probability of Degree Completion by Year 4



Note. The shaded regions represent the 95% confidence interval.

Figure 7. Hierarchical Logistic Regression Model Predicting Probability of Degree Completion by Year 6



Note. The shaded regions represent the 95% confidence interval.

Discussion

Effectively predicting academic success is essential for providing students with the resources they need to succeed in their careers and for matching individuals to postsecondary institutions that suit their needs. As detailed earlier in this paper, a variety of work indicates that both ACTC score and HSGPA are valuable tools for predicting both early success in college (as measured via FYGPA) and longer-term degree completion outcomes (Mattern & Patterson, 2013; Radunzel & Mattern, 2020). Including ACTC score in models of academic performance has consistently been shown to improve their predictive power (Allensworth & Clark, 2020; Chen & Sanchez, 2024; Radunzel & Noble, 2012a). Degree completion is one of the most important metrics of academic success, as it most directly translates to improved job prospects for students. For example, data from the U.S. Bureau of Labor Statistics (2024b) suggest that between 2023 and 2032, the number of available jobs requiring only a high school diploma is expected to increase much less (0.9% increase) than the number of available jobs requiring a bachelor's degree (6.7%), a master's degree (11.3%), or a doctoral or professional degree (7.0%). The number of jobs that require only some college with no degree is actually expected to decrease slightly (−2.2%). Data like this highlight the impact of effectively predicting degree completion outcomes; degree completion is the educational outcome that provides the most tangible direct benefits to students. Prior work also highlights the importance of FYGPA as a means for predicting persistence to degree completion. Early success in college is consistently one of the strongest and most reliable predictors of students' timely degree completion (Demeter et al., 2022). Because of the utility of FYGPA in predicting degree completion and degree completion's importance to student career success, accurate prediction of FYGPA is vital.

In this study, we have expanded on prior research by examining the path by which ACTC score and HSGPA can be used to directly predict FYGPA and, in turn, to indirectly predict the probability of degree completion. A better understanding of these connections can improve the predictive validity of future models that can aid admissions decisions and help colleges appropriately allocate resources to students who may be at risk of attrition due to early academic challenges.

To answer our first research question, we used path analysis to assess the role of FYGPA as a mediator of the effect of ACTC score and HSGPA on degree completion by Years 4 and 6. For the probability of degree completion by both Years 4 and 6, we find that FYGPA is a significant mediator of these effects, with both indirect effects (for ACTC score and HSGPA) being significant in both models. Additionally, HSGPA and ACTC score both had significant direct effects on the probability of degree completion by Years 4 and 6, as well as on FYGPA. In fact, all paths tested were significant. The direct effect of ACTC score on the probability of degree completion for both Years 4 and 6 was larger than that of HSGPA. Interestingly, this was reversed for indirect effects via FYGPA, with the indirect effect of HSGPA being larger than that of ACTC score.

We used more complex hierarchical models to further explore the relationship between using both ACTC score and HSGPA together and the probability of degree completion by Years 4 and 6 after FYGPA is accounted for. Notably, there is a significant interaction effect such that ACTC score was more strongly positively related to the probability of degree completion by Year 4 for students with higher HSGPAs. This is consistent with prior work that suggests that ACTC score adds the most predictive power in models of academic success for high-achieving students (Radunzel & Noble, 2012b; Sawyer, 2010). Also of note, this interaction between HSGPA and ACTC score falls below significance when predictions are extended to degree completion by Year 6. Other results were largely consistent with the path models, finding that ACTC score and HSGPA were both significant predictors of the probability of degree completion by Years 4 and 6. FYGPA remains the strongest predictor of degree completion at both years, with ACTC score and HSGPA improving the predictions in both models. These models also include demographic predictor variables, which were family income, race/ethnicity, and gender. Several of these demographic variables were significant predictors of degree completion by Years 4 and 6; most consistently, higher income levels predicted a greater probability of degree completion by both years.

Across all models in this paper, we find that ACTC score, HSGPA, and FYGPA each add unique predictive validity above and beyond demographic variables to models predicting degree completion by Years 4 and 6. These findings offer further support for the conclusion that even when FYGPA is controlled for, ACTC score is a high-quality and valid predictor of academic success that improves models, particularly when used in conjunction with other predictors of achievement like HSGPA. Path analysis supports the conclusion that ACTC score and HSGPA not only have direct effects on the probability of degree completion by Years 4 and 6 but also effectively predict degree completion via FYGPA as a mediator.

Using all these predictors together offers more accurate predictions of degree completion at the 4-year and 6-year time points across a wide range of students. Our results suggest that the accuracy of these models can be further improved by modeling the indirect effects of ACTC score and HSGPA. By using both these indirect effects and ACTC score and HSGPA to more accurately predict FYGPA, postsecondary schools can identify students with high support needs before these students enter college. Helping students avoid poor performance early on in college will improve their ability to complete their degrees.

Implications

These findings have important implications for students and administrators alike. For students, having access to both ACTC score and HSGPA as achievement indicators means they have a more complete look at their preparedness for college in both the short and long term. Awareness that these pre-college indicators not only contribute to postsecondary school acceptance decisions but also predict FYGPA and the probability of degree completion may offer students further incentive to improve their academic performance. As both ACTC score and HSGPA add predictive validity to college outcomes, students can take multiple routes to improve their college preparedness and chances of admission, especially if one predictor is weaker than the other. Research has shown that educational outcomes differ depending on discrepancy between ACTC score and HSGPA (e.g., Edmunds, 2010; Kobrin et al., 2002; Mattern et al., 2010; Mattern et al., 2011). For example, students earning high HSGPAs but lower ACTC scores can work to improve test-taking strategies and key college readiness skills, while students with high ACTC scores but lower HSGPAs can focus on improving things like organization and timely management of assignments. Both measures are useful for students aiming to better understand where to most effectively focus their efforts to improve their college and eventual career prospects.

Secondary-school educators, councilors, and advisors who have access to both HSGPA and ACTC score as pre-college indicators can improve the quality of career guidance they offer. Because both HSGPA and ACTC score offer incremental information on postsecondary preparedness, students are likely to receive better advising from mentors using both ACTC score and HSGPA. When using more information, advisors will be better able to recognize if a student is likely to struggle at a highly selective institution and recommend appropriate support. Similarly, guidance counselors can make better recommendations about which postsecondary school a student is most likely to complete their degree at.

Finally, for college administrators, using both ACTC score and HSGPA as predictors of college performance can improve both accuracy and consistency in admissions decisions and the allocation of support resources. Highly selective colleges and universities with limited admissions slots can use both metrics to make better predictions about which students will be successful on long-term outcomes. Past work suggests that ACTC score may be most useful at highly selective schools (Sawyer, 2010). ACTC score and HSGPA also have substantial utility for less selective schools. In many cases, colleges have limited resources, so identifying students most in need of support is vital both for helping students succeed and for helping postsecondary schools maintain lower attrition rates. Schools that can allocate resources to help students who are most likely to struggle are likely to have lower attrition rates (Nelson et al., 2009). This benefits both students, who are likely to earn higher lifetime wages with successful degree completion (U.S. Bureau of Labor Statistics, 2024a), and colleges, which improve their success metrics and potential funding.

Universities should of course take a holistic approach to admissions decisions in predicting collegiate success, considering things such as an applicant's demonstrated interest and leadership, as well as the university's own equity and inclusion values. Including ACTC score in relevant decision-making models helps colleges more accurately and consistently assess an applicant's cognitive ability.

The use of all available predictive tools by each of these groups (students, educators, and administrators) coalesces to help students reach their long-term goals. Students can use their ACTC score and HSGPA to inform their discussions with guidance counselors, who can in turn help students make college decisions. Administrators can use these same measures to aid in admissions decisions by predicting outcomes such as FYGPA and degree completion probability. Further, once students are accepted into a postsecondary school, college administrators and advisors can intervene if a student's FYGPA is lower than expected. By offering supports to these students, colleges can reduce possible attrition. When used holistically, predictors like HSGPA and ACTC score benefit students in various ways.

Overall, we see substantial evidence in this study that both ACTC score and HSGPA add incremental predictive utility to models of long-term college success. Both are useful not only as direct predictors of successful graduation by Years 4 and 6 but also as indirect predictors of degree completion via FYGPA. By using both ACTC score and HSGPA, college administrators can develop a more holistic picture of a student's academic readiness and need.

Limitations

It is worth noting five limitations of this study. First, this project is limited to one U.S. state. As such, findings cannot definitively be generalized across the country without further research. Despite this, the large sample included here makes for a promising direction. Second, due to the nature of the topics of interest, all predictors and variables in this project were observed rather than experimentally manipulated. This limits causal conclusions. Third, we did not look at institutional selectivity, which may also provide more context for our findings. Fourth, we followed students through their first year at the institution they enrolled in. This means that students who transferred out of that institution or dropped out would be represented by whatever FYGPA information was available. Future research should tease out this distinction, as well as exploring differences by student majors. Finally, we did not explicitly explore the impact of the COVID-19 pandemic. The 2017 cohort had interruptions to their education due to the pandemic, and it is unclear how this may have impacted graduation rates. Despite these limitations, we find valuable evidence of a predictive pattern in both the hierarchical and path models.

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