Predictors of On-time High School Graduation

In this brief, the Oregon Department of Education (ODE) presents new analysis of the relationship between the 9th grade on-track measure, on-time (4-year) high school graduation rates, and other predictive factors in early high school grades, using the records of more than 130,000 Oregon students across three graduating cohorts to assist in identifying areas in need of additional supports. This research serves to validate the High School Success initiative's focus on on-track rates, attendance, access to higher-level coursework, and CTE participation, in support of local efforts to increase graduation rates.

The High School Success initiative originated with Measure 98, a ballot measure approved by Oregon voters in 2016. The initiative directed funding for the "purposes of improving the graduation rates and college and career readiness of all high school students in Oregon,"[1] and established three primary areas on which funds allocated under this initiative can be spent: career and technical education, college-level opportunities, and dropout-prevention strategies.
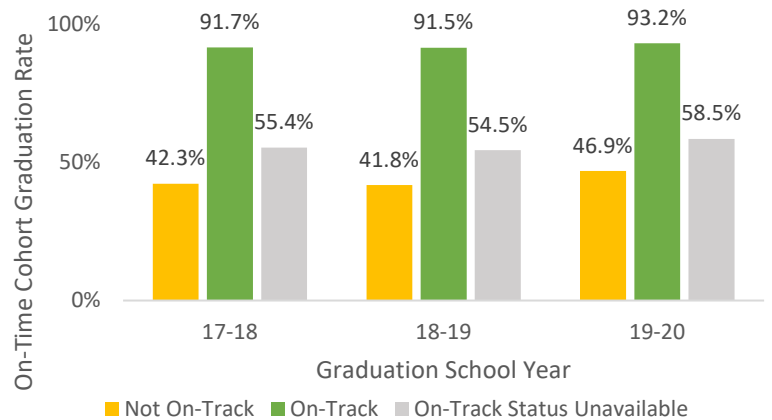
Key Takeaways

- Being on-track in 9th grade is strongly predictive of on-time graduation.
- Regular attendance, course enrollment, mobility, and discipline are also important predictors of graduation.
- Many important factors have stronger predictive power as a secondary indicator, among students who were not on-track in 9th grade.

Dropout Prevention Strategies

While data is not available for all of the identified strategies within dropout prevention, districts and schools are directed to reduce chronic absenteeism[2] (increase regular attendance) and provide supports for students to ensure that they are on-track to graduate by the time they enter grade 10.[3] Early data[4] indicated that these are likely to be good indicators of students at risk of not graduating. As focus on improving these indicators increases, the High School Success team hopes to see the strong relationship continue.

This analysis uses data for the most recent graduating cohorts[5] to evaluate the continued predictive effectiveness of absenteeism, on-track, and other metrics on the likelihood of four-year graduation. The chart to the right shows that even as on-track rates increase[6] over time, the on-track measure remains a strong predictor of graduation at the student level.

Students who are On-Track in 9th Grade are Consistently Twice as Likely to Graduate

On-Time Cohort Graduation Rate

Graduation School Year	Not On-Track	On-Track	On-Track Status Unavailable
17-18	42.3%	91.7%	55.4%
18-19	41.8%	91.5%	54.5%
19-20	46.9%	93.2%	58.5%

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[1] ORS 327.856 (1)

[2] Chronic absenteeism is defined as the proportion of students who attended 90% or less of the days they were enrolled. Regular attendance is the inverse: the proportion of students who attended more than 90% of the days they were enrolled.

[3] On-track to graduate in 9th grade is defined as the proportion of students who had earned at least 25% of the credits needed to be awarded a standard high school diploma by the beginning of their 10th grade year.

[4] On-Track Status as a Predictor of Graduation. Note that this work uses slightly different inclusion rules than accountability data briefs, including all students for whom ODE has data, even those with short or fragmented enrollment patterns.
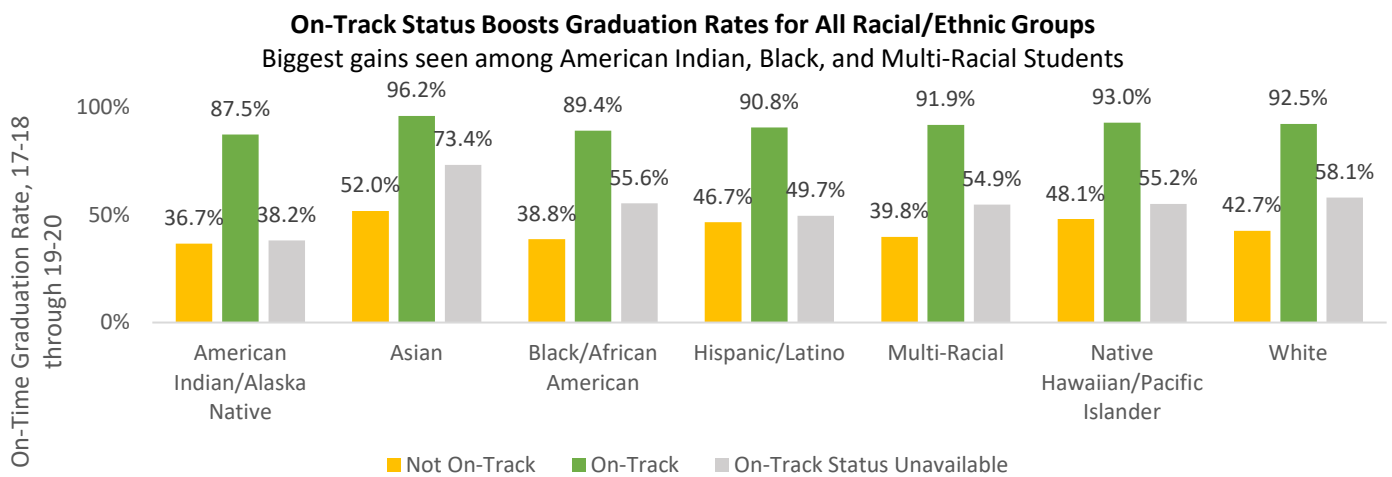
[5] Due to the impact of the COVID-19 pandemic on the end of the 2019-20 school year, some measures of 12th grade enrollment and attendance for the graduating class of 2019-20 (high school entry year 2016-17) are excluded. Also excluded are students whose on-track status is unavailable due to not being enrolled in an Oregon high school in May of their 9th grade year, shown in grey in the chart above.

[6] https://www.oregon.gov/ode/schools-and-districts/reportcards/Documents/rptcard2019.pdf

Throughout this brief, predictive relationships will be phrased as risk ratios, which can be interpreted as a multiplying effect on a student's likelihood (or "risk") of graduation, compared to a baseline group. For example, a risk ratio of 1.5 for a given group of students would indicate that students in the group are 1.5 times *as likely* to graduate as students not in the group. The same ratio can also be interpreted as 50% *more likely* to graduate than students not in the group. A risk ratio of 1.0 indicates no difference in risk between groups, while risk ratios below 1.0 indicate that the group is *less* likely to graduate: for example, a risk ratio of 0.75 indicates that students are 0.75 times *as likely* to graduate, or 25% *less likely* to graduate as students not in the group.
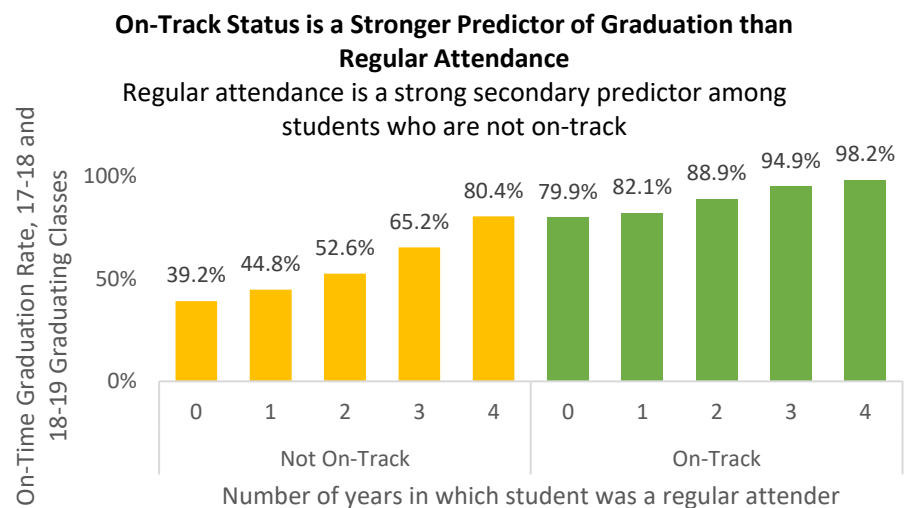
Students who were on-track as ninth graders are more than twice as likely to graduate on time in 2017-18 and 2018-19 (risk ratio 2.2), and twice as likely to graduate on time in 2019-20 (risk ratio 2.0), which is consistent with previous research on this topic both within Oregon and nationally.[7]

As shown in the graph below, on-track rates vary between racial and ethnic groups, but on-track status remains a strong predictor for all groups, with risk ratios ranging from 1.9 (90% more likely) for Asian students to 2.4 (more than twice as likely) for American Indian/Alaska Native students.

On-Track Status Boosts Graduation Rates for All Racial/Ethnic Groups
Biggest gains seen among American Indian, Black, and Multi-Racial Students

Regular Attendance also Boosts Graduation Rates

Although on-track status is the strongest predictor of graduation in this evaluation, adding regular attendance to the mix helps to differentiate outcomes, particularly for students who are not on-track. For students who were on-track in 9th grade, being regular attenders was associated with an on-time graduation rate of 94% (compared to 80% for chronically absent on-track students, a risk ratio of 1.2). For students who were not on-track, being a regular attender in 9th grade was associated with an on-time graduation rate of 56% (compared to 32% for chronically absent students who are not on track, a risk ratio of 1.8), which is a substantial increase, though overall rates for this group remain low.

On-Track Status is a Stronger Predictor of Graduation than Regular Attendance
Regular attendance is a strong secondary predictor among students who are not on-track

[7] Norbury, H., Wong, M., Wan, M., Reese, K., Dhillon, S., and Gerdeman, R. (2012). Using the freshman on-track indicator to predict graduation in two urban districts in the Midwest Region. (Issues & Answers Report, REL 2012–No.134). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest. Retrieved from http://ies.ed.gov/ncee/edlabs.

Combining Data to Better Understand the Cumulative Impact on Graduation

Adding ninth grade regular attendance as a secondary indicator for students without enough credits to be counted as on-track enhances our predictions. However, combining it with the on-track credits measure to form a single metric for predicting graduation, as seen in some of the literature, increases the misclassification rate (the proportion of students who would be incorrectly predicted to graduate or not) over the on-track credits measure alone (from 14.5% to 20.7% of students misclassified, most incorrectly predicted to be non-graduates).

Further evaluating the relationship between regular attendance and on-track status, the graph on the previous page shows that students who were not on-track must be regular attenders in all four years of high school to reach an equivalent likelihood of graduation to those students who were on-track but consistently chronically absent.[8] Schools must do more to support these students, including helping them become and remain on-track to graduate.

Modelling the Combined Impact of Multiple Factors

Using a binary classifier tree model[9] on early (freshman and sophomore year) high school indicators (mobility, attendance, discipline, math course, and on-track status) and demographics, the analysis finds that on-track status is identified as the strongest top-level predictor, indicating that it provides the greatest degree of separation between graduates and non-graduates. Attendance in the sophomore year was a strong secondary predictor for students who were not on-track, with the greatest differentiation occurring at an attendance rate of 81%, slightly lower than the recognized chronic absenteeism threshold, but consistent with prior research.[10]

Classification Tree for Predicted Probability of On-Time Graduation

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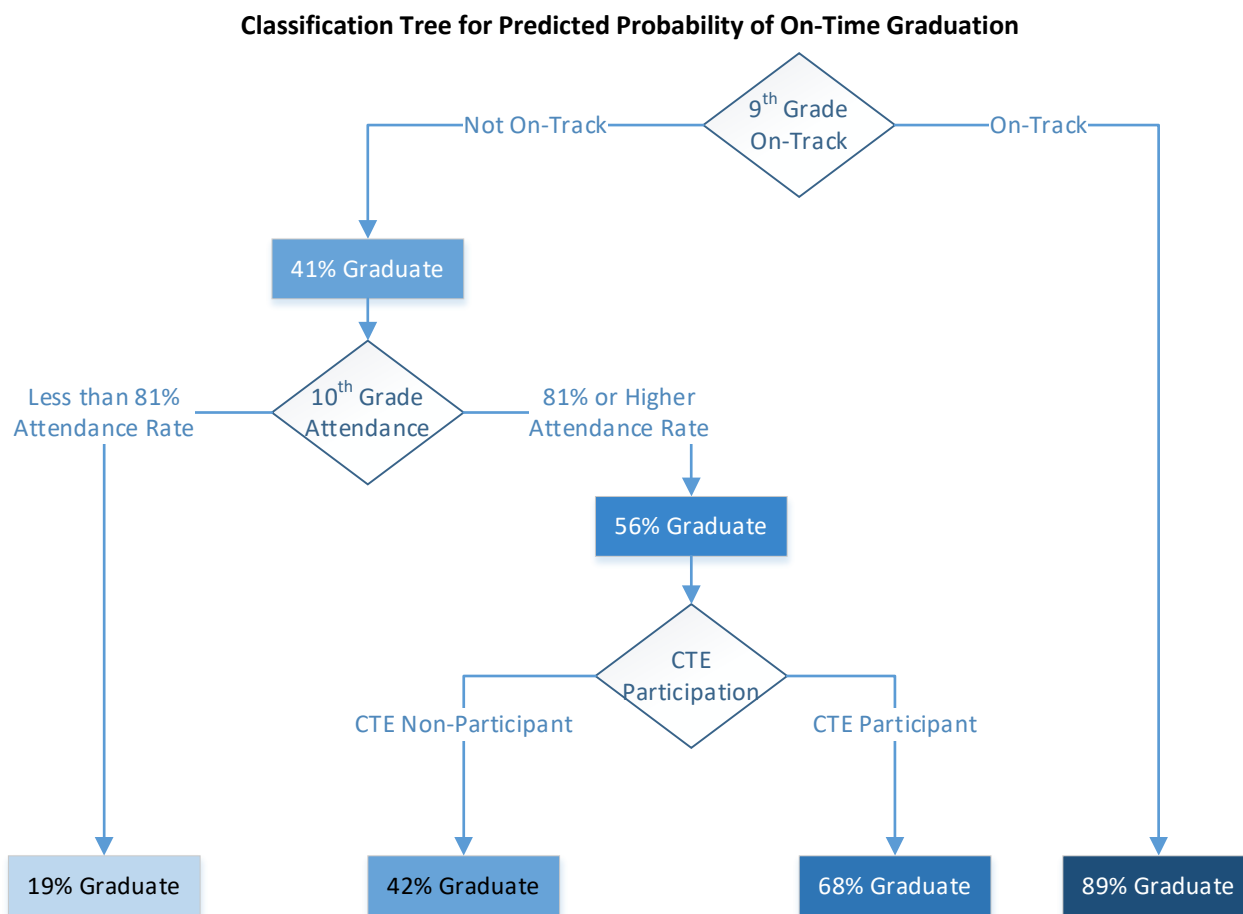
[8] Excluding students who did not have enrollment in each of the four years, and students in the 19-20 cohort, for whom the coronavirus pandemic and related school closures disrupted senior year attendance patterns and data collection.

[9] Terry Therneau and Beth Atkinson (2019). rpart: Recursive Partitioning and Regression Trees. R package version 4.1-15.
https://CRAN.R-project.org/package=rpart

[10] *Outcomes Five Years After Entering High School vs. Freshman Year* Attendance, Oregon Statewide Report Card 2013-14, page 79.
https://www.oregon.gov/ode/schools-and-districts/reportcards/Documents/rptcard2014.pdf

Among students with high 10th grade attendance, the model also identifies CTE Participation (completing at least 0.5 credits of Career and Technical Education in any year of high school) as a strong predictor of graduation. Together, the model provides estimates ranging from an 89% probability of graduation (among on-track students) to a 19% probability of graduation (among off-track students with low attendance rates).

Rerunning the model including only students of historically underserved race/ethnicity returns virtually identical results, indicating that these predictors remain strong for Black/African American, Hispanic/Latino/a, American Indian/Alaska Native, and Native Hawaiian/Pacific Islander students. While neither this model nor the model below identified race/ethnicity as an explicitly predictive factor of significance, this should not be interpreted to mean that student race/ethnicity does not shape their experiences in schools; rather that a student's experience as a member of a given race/ethnicity may impact the likelihood of the student being on-track in very similar ways to its impact on the likelihood of the student graduating.

Relationships between Student Risk Factors

To further explore these relationships, this analysis concludes with a model[11,12] to describe the relationship between student risk and protective factors—including on-track status, regular attendance, math and CTE enrollment, mobility, student group membership, and discipline—and the likelihood ("risk") of a student's on-time graduation. As in the prior analyses, this finds that on-track status is the strongest predictor, with students who are on-track more than twice as likely as their off-track peers to graduate on time (relative risk 2.11; i.e. on-track students are 2.11 times as likely as off-track students to graduate on time).

Some demographic and economic factors were broadly applicable (for example, experiencing houselessness was associated with a 10% reduction in the likelihood of graduating—risk ratio 0.90—across the board), but many had an interaction with on-track status, indicating that the effect of the predictor is much stronger for students who were not on-track. For example, regular attendance in 9th grade was associated with a 17% increased likelihood of graduation among students who were not on-track, but only a 5% increased likelihood of graduation among those who were on-track. In those cases, the relative risks are presented separately for the two groups in the table below.

	All Students, Adjusted Relative Risk (95% Confidence Interval) for On-time Graduation >1.0 indicates a positive effect, <1.0 indicates a negative effect	
Ninth Grade On-Track	↑ 2.11 (2.03 – 2.19)	
Students with Disabilities	↓ 0.94 (0.93 – 0.95)	
Students experiencing Poverty[13]	↓ 0.97 (0.97 – 0.98)	
Students experiencing Houselessness	↓ 0.90 (0.89 – 0.91)	
9th Grade Mobility[14]	↓ 0.92 (0.91 – 0.94)	
9th Grade Discipline[15] (per incident)	↓ 0.96 (0.95 – 0.97)	
10th Grade Discipline (per incident)	↓ 0.94 (0.93 – 0.95)	
	Students Not On-Track	**On-Track Students**
9th Grade Regular Attender	↑ 1.17 (1.13 – 1.20)	↑ 1.05 (1.04 – 1.06)
10th Grade Regular Attender	↑ 1.43 (1.39 – 1.48)	↑ 1.11 (1.10 – 1.12)
Male Students[16], vs. Female Students	↓ 0.81 (0.78 – 0.83)	↓ 0.97 (0.97 – 0.97)
10th Grade Mobility	↓ 0.53 (0.50 – 0.55)	↓ 0.79 (0.78 – 0.80)
CTE Participation	↑ 1.61 (1.56 – 1.66)	↑ 1.06 (1.06 – 1.07)

(table continues on next page)

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[11] Poisson regression model with robust standard errors, see Zou, Guangyong. "A Modified Poisson Regression Approach to Prospective Studies with Binary Data." American Journal of Epidemiology 159, no. 7 (2004): 702-06. Accessed 5/13/2021. https://dx.doi.org/10.1093/aje/kwh090.

[12] Zeileis A, Köll S, Graham N (2020). "Various Versatile Variances: An Object-Oriented Implementation of Clustered Covariances in R." *Journal of Statistical Software*, 95(1), 1-36. doi: 10.18637/jss.v095.i01 (URL: https://doi.org/10.18637/jss.v095.i01).

[13] Students who were eligible for free or reduced-price lunch at any point in high school.

[14] Students who entered school late in the school year, left school early in the school year, attended more than one school during the year, or had a gap between enrollments of longer than 10 days.

[15] Defined as the number of in-school suspensions, out of school suspensions, or expulsions the student received during the school year.
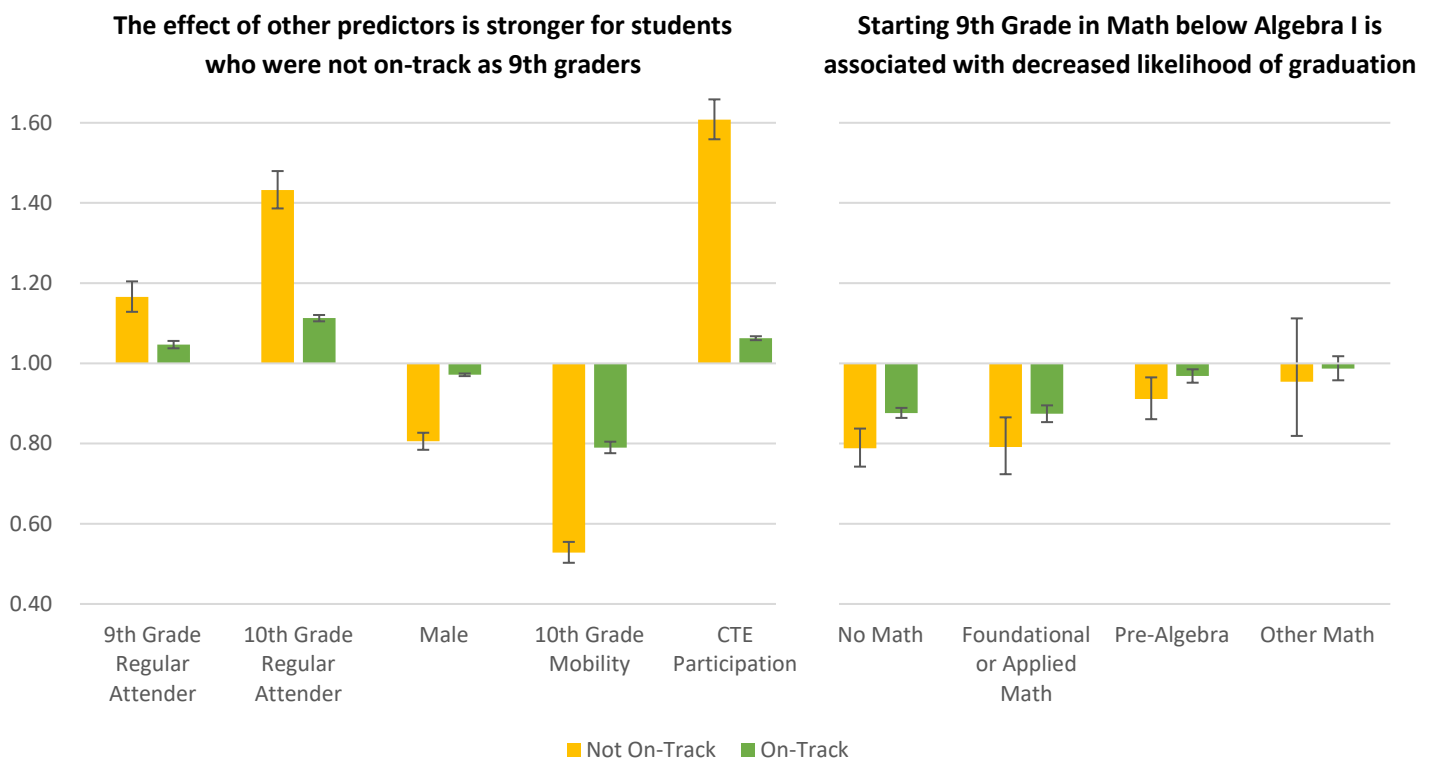
[16] Non-Binary students were included in the model, but likely due to the small number of these students in the dataset, no significant differences between this group and female students were found.

	Students Not On-Track	On-Track Students
9th Grade Math Course, vs. students taking Algebra I or higher[17]		
Foundational or Applied Math	↓ 0.79 (0.72 – 0.87)	↓ 0.87 (0.85 – 0.90)
Pre-Algebra	↓ 0.91 (0.86 – 0.97)	↓ 0.97 (0.95 – 0.99)
Other Math (not significant at p<0.05)	0.95 (0.82 – 1.11)	0.99 (0.96 – 1.02)
No Math	↓ 0.79 (0.74 – 0.84)	↓ 0.88 (0.86 – 0.89)

Enrolling in Algebra I by 9th Grade

National research indicates that passing Algebra I by the end of 9th grade is a strong predictor of graduation[18]. While ODE does not currently have access to course grade and credit data, this analysis shows that merely taking Algebra I (or higher) in 9th grade is associated with an increased likelihood of graduation. After controlling for other factors, no significant differences were seen between Algebra I enrollment and enrollment in higher-level math courses (including Algebra II, Geometry, and Pre-Calculus) in the student's 9th grade year, but enrollment in earlier math courses such as pre-algebra or foundational math was associated with substantial decrease in the likelihood of graduation: up to 21% lower, for students in foundational math courses.

Taking no math course in the 9th grade year was associated with a similarly large decrease in graduation. While many of the students who do not take Algebra I by 9th grade are students with disabilities, there are racial and ethnic disparities in math course-taking even after controlling for disability, which there are plans to explore in future briefs.

The effect of other predictors is stronger for students who were not on-track as 9th graders

Starting 9th Grade in Math below Algebra I is associated with decreased likelihood of graduation

■ Not On-Track ■ On-Track

Adjusted Relative Risks by On-Track Status. 1.0 is baseline risk; 95% confidence intervals shown

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[17] No significant differences were found between students taking Algebra I and students taking higher-level math classes (Algebra II, Geometry, Trigonometry, Pre-calculus, Calculus, etc.) after adjusting for other covariates. The majority of students (54%) in the dataset were enrolled in Algebra I, with an additional 22% enrolled in Geometry, and roughly 5% enrolled in higher-level math.

[18] Silver, David, Marisa Saunders, and Estela Zarate. What factors predict high school graduation in the Los Angeles Unified School District. Santa Barbara, CA: California Dropout Research Project, 2008. http://www.attendancecounts.org/wordpress/wp-content/uploads/2010/04/LAUSD-Study-2008.pdf

The Impact of Successive Discipline Incidents

As also seen in the binary tree classifier model on page 3, factors such as 10th grade attendance and participation in CTE coursework were predictive for both on- and off-track students, but were much more predictive for students who were off-track as 9th graders. Discipline incidents were strongly predictive but relatively rare: about 9% of students had any discipline incidents in 9th grade, and only about 4% had more than one. Incidence is similar for 10th grade, and is not proportionate across student groups.[19]

Though the likelihood of graduation is diminished sharply for students with high rates of discipline incidents, the number of such students in our cohort is quite small: less than 1% had more than four incidents in a year.

Conclusion

Overall, this research demonstrates the importance of efforts to focus High School Success funds on on-track rates, attendance, access to higher-level coursework, and CTE participation, while identifying some areas of intersection that can be used to further focus supports for disadvantaged populations, such as mobile students, students with disabilities, and students experiencing poverty. Further research will investigate the link between these predictors of graduation and the activities supported with High School Success funds to identify promising practices and demonstrate the efficacy of the program. ODE hopes to see additional increases in graduation as a result of investments in these predictors and in supports for at-risk students.

Relative Graduation Likelihood by Number of Discipline Incidents
95% confidence band shown

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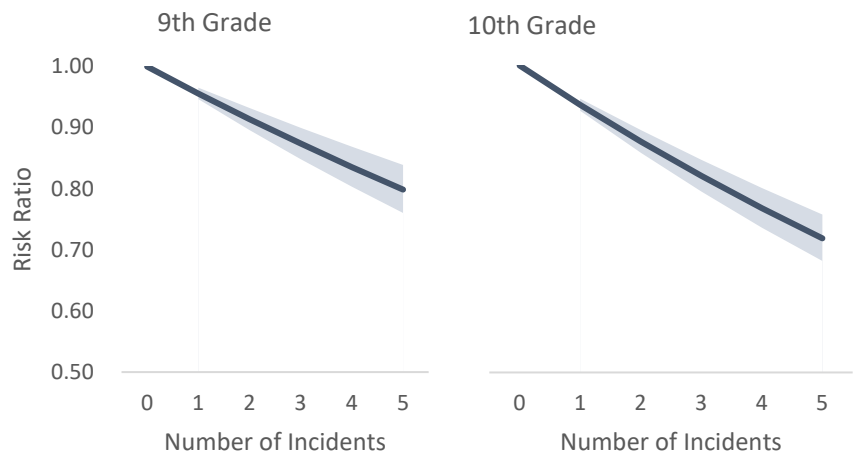
[19] Discipline Incidents by Student Group – Suspensions and Expulsions, Oregon Statewide Report Card 2019-20, page 20.
https://www.oregon.gov/ode/schools-and-districts/reportcards/Documents/rptcard2020.pdf