



## **On-Track but Vulnerable: 9<sup>th</sup> Grade Warning Signs of 10<sup>th</sup> Grade Struggles**

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### **Summary**

This brief focuses on first-time 9<sup>th</sup> graders in 2013-14 who finished the year On-Track (see definition in box to the right). It explores their academic trajectories during the following (10<sup>th</sup> grade) year and through their on-time graduation year of 2016-17.

About two-thirds of these students were On-Track entering 2014-15 (63%). For this analysis, we used Classification and Regression Tree (CART) modeling to divide these On-Track students into four subgroups based on their 9<sup>th</sup> grade GPA and attendance.

A small group of On-Track students (about 1 in 25) showed signs that they were likely to fall off track in later grades. These students had relatively poor grades and attendance in 9<sup>th</sup> grade, and they had a four-year graduation rate of 47%.

### **Background**

Research has shown that the School District of Philadelphia’s (SDP) 9<sup>th</sup> Grade On-Track metric is directly linked to on-time high school graduation.<sup>1</sup> For example, in three recent first-time 9<sup>th</sup> grade cohorts (2011-12 through 2013-14), four-year graduation rates were much higher for On-Track students (87.8-89.2%) than for Off-Track students (43.3-48.8%). This research brief builds on these findings by examining the academic trajectories of SDP students from the 2013-14 first-time 9<sup>th</sup> grade cohort (class of 2017) who were on track to graduate after 9<sup>th</sup> grade.

This is a retrospective analysis because SDP had not yet adopted the On-Track Definition when these students were in 9<sup>th</sup> grade. Although supporting 9<sup>th</sup> graders to meet the On-Track definition was consistent with existing practices, it was not a specific point of District emphasis.

#### **On-Track Definition**

SDP 9<sup>th</sup> graders end the year On-Track if they earn at least one credit in each of the four core subjects (English, math, science, and social studies) and at least five credits in total.

### **Why is this Important?**

SDP’s 9<sup>th</sup> Grade On-Track metric is an established and validated tool for early identification of students who are not likely to graduate on time. About one-third of first-time 9<sup>th</sup> graders in two recent SDP cohorts ended the year Off-Track,<sup>2</sup> making them likely to receive additional targeted supports. However, it is easy to overlook On-Track 9<sup>th</sup> grade students at

<sup>1</sup> Wills, T. (2018). [Defining 9<sup>th</sup> Grade Success: A New 9<sup>th</sup> Grade On-Track Definition](#). Philadelphia: The School District of Philadelphia.

<sup>2</sup> Crofton, M., & Neild, R.C. (2018). [Getting on track to graduation: Ninth graders’ credit accumulation in the School District of Philadelphia, 2014-2016](#). Philadelphia: The Philadelphia Education Research Consortium.

risk of falling off track based on other factors. By understanding key characteristics of On-Track students, we can better identify and serve those who end 9<sup>th</sup> grade On-Track but are vulnerable in 10<sup>th</sup> grade and beyond.

## Research Questions

This brief extends previous analyses by examining two questions:

1. Among 9<sup>th</sup> grade On-Track students, are there 9<sup>th</sup> grade characteristics that predict higher and lower graduation rates? If so, what are these 9<sup>th</sup> grade characteristics?
2. For subgroups of 9<sup>th</sup> grade On-Track students, what were their academic trajectories and Keystone performances through their remaining high school years?

## Methods

The analytic sample in this study includes the 4,936 students who were first-time 9<sup>th</sup> graders in 2013-14 *and* for whom on-time 2016-17 graduation status was available from administrative data.<sup>3</sup> In each specific analysis, a student was included only if there was no missing data for that student. For this reason, the sample sizes for different analyses may vary.

Classification and Regression Tree (CART)<sup>4</sup> methodology was used to identify 9<sup>th</sup> grade predictors of on-time high school graduation among those students who met the 9<sup>th</sup> Grade On-Track definition. CART is a statistical procedure that splits the data into two mutually exclusive groups (see the Technical Appendix for more details). In this case, the model looks for a single value of a single variable that divides the sample into two groups of students: one with a high probability of graduating and one with a low probability. Once the data are divided, the process of finding the next best variable to split the data into smaller and smaller mutually exclusive groups continues until no improvement can be made on the model fit. CART is useful in identifying the variables with the most power to predict a particular outcome (in this case, four-year graduation).

In our CART model, we included metrics previously connected to future academic success, including 9<sup>th</sup> grade attendance, academic performance, and suspensions. The full list of 15 variables used to build the CART model is included in the Technical Appendix.

## What We Found

### **Students who were On-Track in 9<sup>th</sup> grade were more likely to graduate on time, but there are important subgroups of On-Track students.**

Of the 15 variables in the CART model, two emerged as the most useful in identifying subgroups of On-Track students: 9<sup>th</sup> grade Grade Point Average (GPA) and Average Daily Attendance (ADA).<sup>5</sup>

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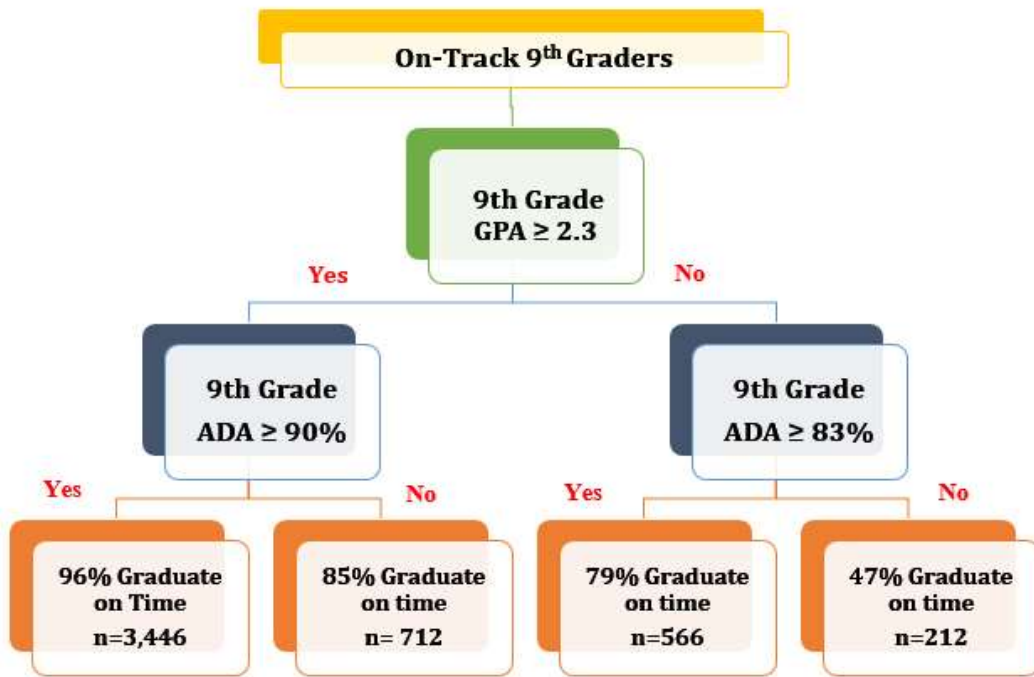
<sup>3</sup> The analytic sample includes students who moved out of SDP schools during/after 9<sup>th</sup> grade and came back before/during 12<sup>th</sup> grade whose final graduation status could be attributed to the School District of Philadelphia. Students who attended charter schools during their 9<sup>th</sup> grade year are excluded from these analyses.

<sup>4</sup> Breiman, L, Friedman, J, Stone, C.J., Olshen., R.A (1984). Classification and Regression Trees. New York: Routledge.

<sup>5</sup> By definition, all On-Track 9<sup>th</sup> grade students have earned five credits by the end of their 9<sup>th</sup> grade year. Therefore, there was little variation in credit accumulation among On-Track students.

These two variables divided the On-Track 9<sup>th</sup> graders into four distinctive subgroups. The CART model shows that if a student was On-Track in 9<sup>th</sup> grade, then 9<sup>th</sup> grade GPA and ADA were the best predictors of *continued* success in high school (Figure 1).

Figure 1. Classification Tree Model Predicting Graduation of On-Track 2013-14 9<sup>th</sup> Grade Cohort (n=4,936)



The results show:

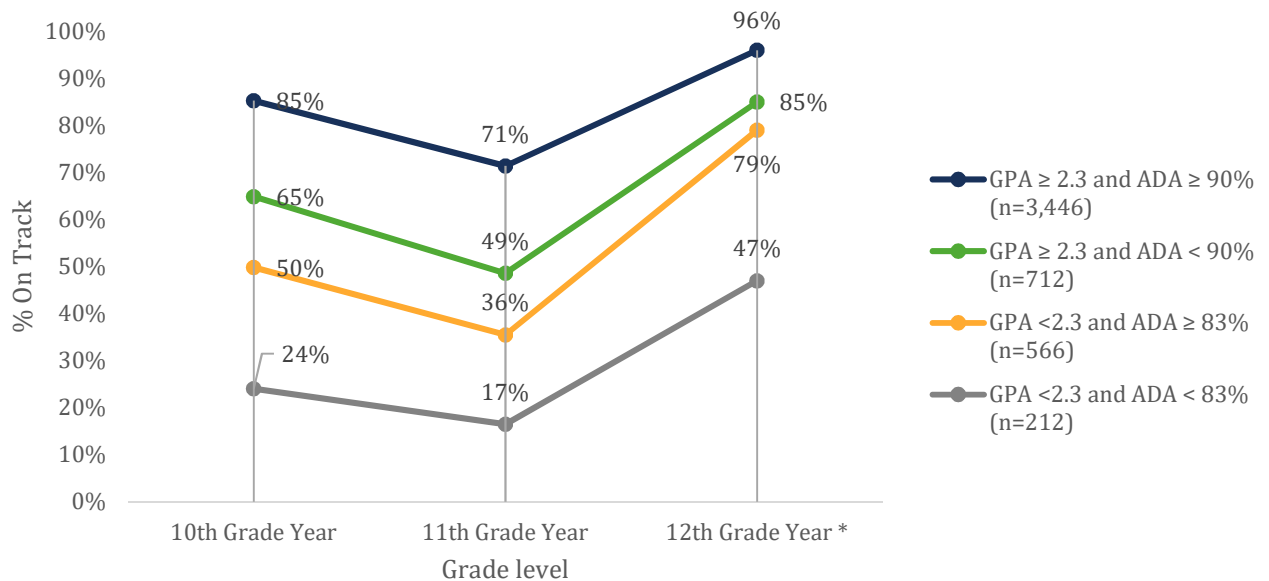
- On-time graduation rates were extremely high (96%) for students who were not only On-Track during 9<sup>th</sup> grade but also had a 9<sup>th</sup> grade GPA of 2.3 or higher *and* a 9<sup>th</sup> grade ADA of 90% or higher. This was the largest subgroup (n=3,446).
- On-Track 9<sup>th</sup> grade students with low 9<sup>th</sup> grade GPAs (<2.3) *and* low 9<sup>th</sup> grade ADA (<83%) had an on-time graduation rate of only 47%. This rate is similar to the graduation rate of Off-Track students (44.6%) estimated in previous analyses.<sup>1</sup> This was the smallest subgroup (n=212).

## Student 10<sup>th</sup>-12<sup>th</sup> grade trajectories and Keystone standardized assessment performance varied according to the 9<sup>th</sup> Grade On-Track subgroups.

Using the subgroups identified by the CART model, we next examined the academic trajectories of each group of students. In 10<sup>th</sup> and 11<sup>th</sup> grades, students needed to accumulate a total of 11 and 17.5 credits, respectively, to be promoted. However, students might earn enough credits to advance, but lack credits in key content areas, making it difficult to satisfy all graduation requirements. For this reason, we chose not to use raw credit accumulation to assess progress through grades 10 and 11. Instead, we retroactively applied new SDP grade-level guidelines that specify optimal credit distribution across content areas.<sup>6</sup>

Students who were On-Track in 9<sup>th</sup> grade with a GPA of 2.3 or higher and ADA of at least 90% stayed On-Track at higher rates than students in other groups (top line in Figure 2). Students who were On-Track in 9<sup>th</sup> grade with a GPA lower than 2.3 and ADA of 83% or lower stayed On-Track at the lowest rates (bottom line in Figure 2). (In their senior year, students across all identified subgroups receive a variety of supports to complete the credits required for graduation; this explains the large increases in On-Track rates between 11<sup>th</sup> and 12<sup>th</sup> grades.) Overall, students with higher 9<sup>th</sup> grade GPAs continued with higher 10<sup>th</sup> and 11<sup>th</sup> grade On-Track rates, as well as higher graduation rates. Student attendance was an additional, secondary predictor of student success.

Figure 2. Trajectories of Subgroups of On-Track 9<sup>th</sup> Graders (2013-14 Cohort) (n=4,936)



\*For the 12<sup>th</sup> grade year, % graduated on time is displayed.

<sup>6</sup> These guidelines were not in effect at that time, so there were no incentives for schools to explicitly target high On-Track rates for 10<sup>th</sup> and 11<sup>th</sup> grades. However, there were (and continue to be) numerous mechanisms in place to help 12<sup>th</sup> graders satisfy outstanding requirements. For these reasons, there is a significant increase from 11<sup>th</sup> grade On-Track rates to 12<sup>th</sup> grade graduation rates for all subgroups.

Students in the subgroups identified by the CART method also had systematically different outcomes on the three Keystone Exams taken by high school students (Literature, Algebra I, and Biology). Students with high GPAs and ADA were more likely to score proficient/advanced on each Keystone exam by 11<sup>th</sup> grade, whereas On-Track 9<sup>th</sup> graders with low GPAs and ADA had the lowest rate of scoring proficient/advanced on each Keystone exam (Table 1). This finding also helps to validate the subgroups, suggesting that they predict general, continued achievement, not just outcomes specific to credit accumulation.

Table 1. Keystone Performance broken by 9<sup>th</sup> Grade (2013-14 Cohort) On-Track Subgroups

9 <sup>th</sup> Grade On-Track Subgroups	% Proficient or Advanced*		
	Literature	Algebra 1	Biology
GPA ≥2.3 and ADA ≥90% (n=3,446)	76%	56%	56%
GPA ≥2.3 and ADA <90% (n=712)	44%	31%	19%
GPA <2.3 and ADA ≥83% (n=566)	25%	14%	7%
GPA <2.3 and ADA <83% (n=212)	14%	8%	4%

**How to read this table:** The four On-Track subgroups in the first column match those identified at the bottom of Figure 1. Within each group, this table shows the percent of students scoring proficient/advanced for each of the three Keystone exams. For example, 76% of students with a GPA greater than or equal to 2.3 and ADA greater than or equal to 90% scored proficient/advanced on the Literature exam, compared to 14% of students with a GPA >2.3 and ADA >83%.

\*Best by 11<sup>th</sup> grade

### Student characteristics are not distributed equally across the 9<sup>th</sup> Grade On-Track subgroups identified using the CART method.

Nearly 70% of the 2013-14 On-Track 9<sup>th</sup> grade cohort had a GPA greater than or equal to 2.3 and ADA greater than or equal to 90%. Within this group, 44.5% were male, 18.9% were White, 47.5% were Black/African American, 12.9% were Hispanic/Latino, 7.7% had Individualized Education Plans (IEPs), and 8.9% were English Learners (column [a], Table 2). However, much larger percentages of male students, Black/African American students, and students with IEPs had GPAs less than 2.3 (column [c], and [d], Table 2). Similarly, English Learners made up 9-10% of each category except for the one defined by a GPA greater than or equal to 2.3 and ADA less than 90%, where they comprised 14% of the group (column [b], Table 2).

Table 2. Demographic Characteristics of 9<sup>th</sup> Grade (2013-14 Cohort) On-Track Subgroups

	9 <sup>th</sup> Grade On-Track (n=4,936)	9 <sup>th</sup> Grade On-Track Subgroups			
		(a) GPA ≥2.3, ADA ≥90% (n=3,446)	(b) GPA ≥2.3, ADA <90% (n=712)	(c) GPA <2.3, ADA ≥83% (n=566)	(d) GPA <2.3, ADA <83% (n=212)
% Male	46.9%	44.5%	43.0%	64.3%	53.8%
<b>Race/Ethnicity</b>					
% White	16.5%	18.9%	15.6%	5.7%	9.4%
% Black/African American	50.6%	47.5%	47.8%	70.3%	59.4%
% Hispanic/Latino	16.0%	12.9%	26.5%	18.0%	25.5%
% with IEPs	12.2 %	7.7%	18.1%	26.1%	28.8%
% English Learners	9.8%	8.9%	14.0%	9.9%	9.9%

**How to read this table:** The four On-Track subgroups listed in columns a-d match the four subgroups identified at the bottom of Figure 1. The largest subgroup is in column (a): students with a GPA greater than or equal to 2.3 and ADA greater than or equal to 90%. Within this group, 44.5% of students were male, 18.9% of students were white, 47.5% of students were Black/African American, 12.9% were Hispanic/Latino, 7.7% had IEPs, and 8.9% were English Learners. These numbers do not add to 100% because students can fall into multiple categories. For further information about the overlapping characteristics of each group, see Appendix B.

## Conclusion

When students meet the 9<sup>th</sup> Grade On-Track definition, they are more likely to graduate on time. However, there are a small group of students who meet the On-Track definition but do so with low grades and poor attendance. These “technically On-Track” students are very likely to fall off track to graduation, in most cases as early as 10<sup>th</sup> grade. Although this group is relatively small, representing about 1 in 25 On-Track students, it still represents hundreds of students.

## Appendix A. Technical Details

### Classification and Regression Tree (CART)

Classification and Regression Tree (CART) is a non-parametric, machine-learning technique for building predictions about binary outcomes, and it is an emerging method in the development of education early warning systems.<sup>7</sup> Unlike traditional regression, CART does not make assumptions about the distribution of underlying data, and it can be used to identify both the set of most predictive variables and also their best cut points for making predictions. For example, our CART analysis indicates that GPA is a strong predictor, but it also tells us that a GPA of 2.3 is the cut point that produces the best predictions.

In our CART model, we included metrics that have previously been connected to future academic success. The full list of 15 variables used to build the CART model are provided below. Average Daily Attendance (ADA) and Grade Point Average (GPA) were the two variables identified as most predictive of on-time graduation among the On-Track students.

### Characteristics of On-Track 9<sup>th</sup> grade students included in the CART model predicting on-time graduation

#### 9<sup>th</sup> Grade Attendance Data

1. Number of days enrolled
2. Number of excused absences
3. Number of unexcused absences
4. Number of days absent due to Out-of-School Suspension
5. Average Daily Attendance (ADA)

#### 9<sup>th</sup> Grade Academic Data

6. Grade Point Average (GPA)
7. Number of English credits earned
8. Number of Math credits earned
9. Number of Science credits earned
10. Number of Social Studies credits earned

#### 9<sup>th</sup> Grade Discipline Data

11. Number of Out-of-School Suspensions
12. Number of In-School Suspensions

#### 9<sup>th</sup> Grade Keystone Data

13. Algebra 1 Keystone (1= if taken during 9<sup>th</sup> grade; 0 if not taken during 9<sup>th</sup> grade)
14. Literature Keystone (1= if taken during 9<sup>th</sup> grade; 0 if not taken during 9<sup>th</sup> grade)
15. Biology Keystone (1= if taken during 9<sup>th</sup> grade; 0 if not taken during 9<sup>th</sup> grade)

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<sup>7</sup> Koon, S., & Petscher Y. (2015). Comparing methodologies for developing an early warning system: Classification and regression tree versus logistic regression.

## Appendix B. Group Composition Details

### How to read these figures

This Appendix presents four figures—one for each of the four On-Track subgroups. Each Venn diagram shows the number of students falling into four selected demographic categories: Black/African American students, students with IEPs, English Learners (EL), and male students. For example, Figure B1 shows the largest 9<sup>th</sup> grade On-Track subgroup. In this group, 124 students were male English Learners (the intersection of the male and English Learner ovals). Similarly, 55 students in this group were Black/African American students with IEPs. The overlapping ovals also show the number of students in three groups (13 male students who are English Learners and have IEPs, for example) and four groups (one Black/African American, male, English Learner with an IEP in this On-Track group).

Figure B1. Overlapping Selected Characteristics of the 9<sup>th</sup> Grade On-Track Subgroup with GPA  $\geq 2.3$  and ADA  $\geq 90\%$  (n=3,446)

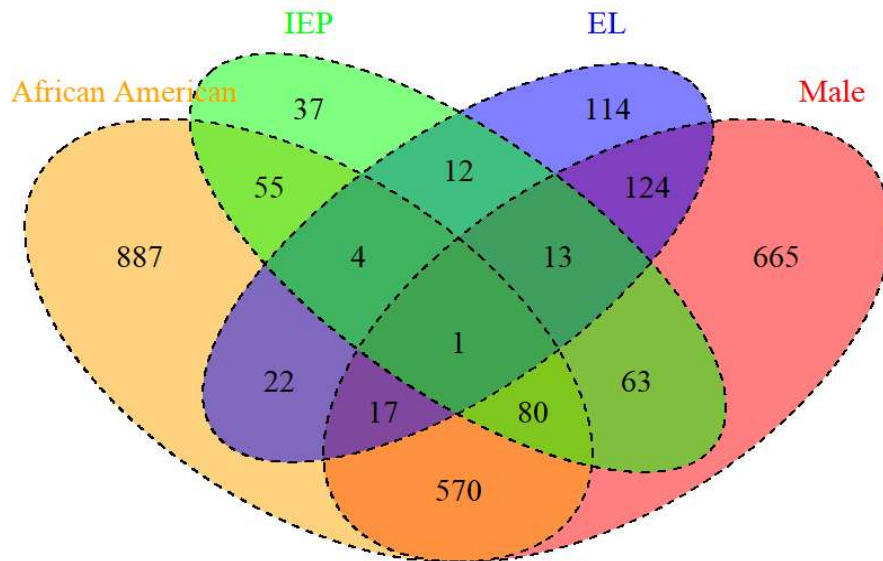




Figure B2. Overlapping Selected Characteristics of the 9<sup>th</sup> Grade On-Track Subgroup with GPA  $\geq 2.3$  and ADA  $< 90\%$  (n=712)

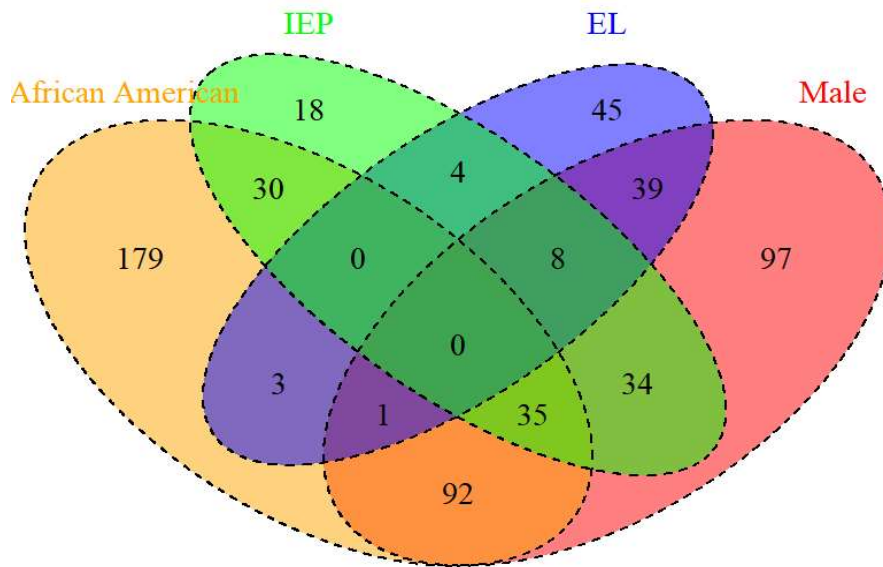


Figure B3. Overlapping Selected Characteristics of the 9<sup>th</sup> Grade On-Track Subgroup with GPA  $< 2.3$  and ADA  $\geq 83\%$  (n=566)

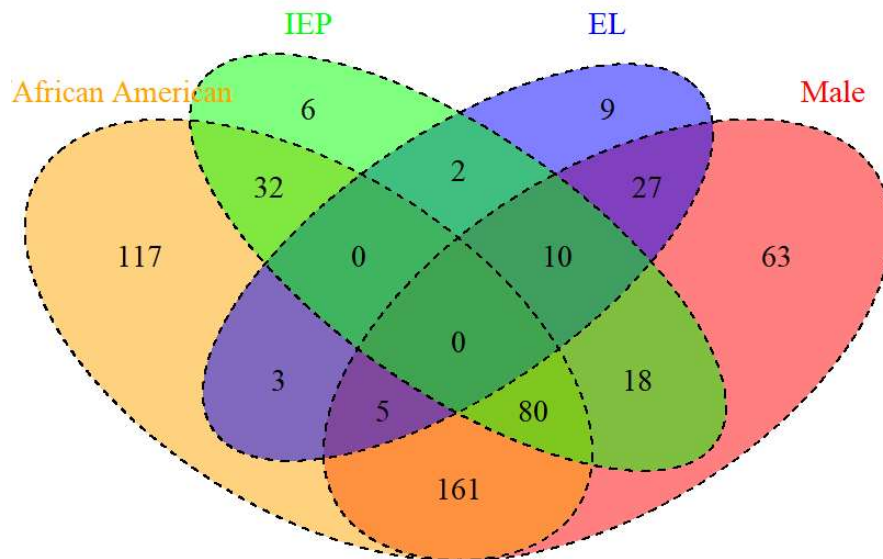


Figure B4. Overlapping Selected Characteristics of the 9<sup>th</sup> Grade On-Track Subgroup with GPA <2.3 and ADA <83% (n=212)

