



Washington Office of Superintendent of
PUBLIC INSTRUCTION

*Kindergarten Readiness and
3rd Grade Outcomes:
A Predictive Analysis Using
2015–16 WaKIDS and 2018–
19 3rd Grade SBA Data*

KINDERGARTEN READINESS AND 3RD GRADE OUTCOMES:

*A Predictive Analysis Using 2015–16 WaKIDS and 2018–19 3rd
Grade SBA Data.*

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EXECUTIVE SUMMARY

Studies have found that kindergarten school readiness is strongly associated with later academic achievement. However, children's development is influenced by factors such as access to affordable early learning and childcare, stable housing and nutrition. As a result of historical segregation and institutionalized racism, not all communities have equal access to these resources. Consequently, research has found that students of color and from low-income families are less likely to be kindergarten-ready, and therefore set up to fall behind in later years. The following study shows that Washington State is no exception.

The Office of Superintendent of Public Instruction (OSPI) used multilevel logistic regressions to analyze whether kindergarten readiness, as assessed by the Washington Kindergarten Inventory of Developing Skills (WaKIDS), predicted 3rd grade Smarter Balanced Assessments (SBA) outcomes in math and English Language Arts (ELA). The dataset included matched student records from the 2015–16 WaKIDS kindergarten cohort and their 2018–19 3rd grade SBA results, in a study of 43,458 students.

Key Findings

- Kindergarten readiness predicted whether students met 3rd grade SBA standards, even after controlling for student characteristics. The odds of meeting ELA standards were 1.62 times greater for students who were kindergarten-ready in literacy compared to students who were not. Likewise, the odds of meeting math standards were 1.72 times greater for students who were kindergarten-ready in math. There were also cross-domain effects. ELA SBA proficiency was also predicted by math, cognitive and physical readiness. Math SBA proficiency was also predicted by literacy, cognitive, and social-emotional readiness.
- Among students who were kindergarten-ready in literacy and math, those who didn't meet 3rd grade SBA standards were more likely to be American Indian/Alaskan Native, Black/African American, Hispanic/Latino of any race(s), Native Hawaiian/Other Pacific Islander, Multilingual/English learners, from low-income families, students with disabilities, not marked as regularly attending school, been suspended or expelled, received Learning Assistance Program (LAP) services and changed schools more often. Additionally, female students appear more likely to fall behind in math, and male students in ELA.
- Statistically significant opportunity gaps in literacy and math persisted from kindergarten to 3rd grade and also widened between most student groups. Additionally, significant opportunity gaps were observed and widened in both subjects between students identified as White and students identified as other races/ethnicities, except for students identified as Asian. While there was no significant difference between White and Asian students in kindergarten, the gap widened and became significant by 3rd grade. Hispanic/Latino students were the only racial/ethnic group that experienced a narrowing of the gap compared to White students, though the gap remained significant.

This study has several limitations. First, this study uses OSPI administrative data and as a result many student-level variables act as proxies for more complex environmental and structural factors that have historically disadvantaged certain student groups, particularly students of color. Consequently, when considering potential policy implications based on these findings, the reader should consider how to address the underlying barriers impacting a student's ability to succeed (e.g. accessibility to early education programs).

Second, WaKIDS and SBA use very different methods to assess skill level and direct comparisons should be made with caution. Furthermore, WaKIDS scores may be biased by factors such as the quality and recentness of teacher training, level of administrative support received, early education knowledge and implicit bias, all of which are unaccounted for in this study. Additionally, because WaKIDS was not yet fully rolled-out in 2015–16, the matched cohort is not a representative sample of statewide populations. Findings are also only based on one cohort and one year of SBA results. Therefore, generalizations beyond this sample are limited.

Finally, after completion of the analysis and just prior to publication of this research brief, OSPI learned there were changes to the readiness cut scores used by Teaching Strategies GOLD® across school years relevant to this study. Although the changes are not insignificant, initial review indicates that they do not substantially impact the patterns or trends observed in this analysis. Future analysis will address this issue more completely and could integrate more years of data to make the data for representative of the state population and make the findings more generalizable. Future studies should also incorporate educator experience, certification, and demographics to examine the role of educator characteristics.

INTRODUCTION

Research demonstrates that students who enter school with strong skills, particularly in literacy and math, are more likely to succeed in later academic years. Additional research shows that high school graduation rates can be predicted as early as 3rd grade. However, many students, particular students of color and students facing financial hardship, often face barriers to accessing the social and economic resources necessary to invest in quality early learning and development, and consequently students enter school with lower rates of kindergarten readiness than their White and affluent peers.

If long-term student outcomes can be predicted based on early achievement indicators, being able to predict elementary school outcomes as early as kindergarten would help families, educators and policymakers identify early areas of support. Subsequent interventions at an early age would be proactive in building sustainable support structures for students and families, as opposed to reactive interventions that may be more costly and less effective.

In this study, the term “opportunity gap” is used instead of “achievement gap” and is defined as “systemic inequities that structurally disadvantage the experience and the opportunities of students of color in the public education system” (Educational Opportunity Gap Oversight and Accountability Committee (EOGOAC), 2020, page 3). Put another way, these gaps are the symptom of a more deeply rooted condition that must be addressed because even “if the United States solved the achievement gap...but did not address the groundwater of structural racism, the achievement gap would literally re-emerge over time” (Hayes-Greene and Love, 2018, page 8).

The present study seeks to identify whether kindergarten readiness predicts achievement in elementary school by using WaKIDS and 3rd grade SBA data from the 2015–16 kindergarten cohort, sourced from OSPI’s Comprehensive Education and Data Research System (CEDARS). It also identifies gaps in readiness and SBA proficiency across student groups, whether these gaps persist, narrow or widen over time, and whether certain student groups are not receiving sufficient educational supports, as indicated by not meeting 3rd grade SBA standards despite entering kindergarten with strong literacy and math skills.

LITERATURE REVIEW

What Is School Readiness?

Children’s transition into kindergarten and formal schooling is a complex and important stage in their development. While many states use some form of kindergarten-entry assessment to identify incoming students’ skill levels (Shields et al., 2016), debate exists regarding how to define school readiness and whether it can be measured in an accurate, useful and unharmed fashion (Meisels, 1998; Pianta and Walsh, 1996). Meisels (1998) identifies four common interpretations of school readiness: readiness as a function of a child’s maturation, proficiency in a set of specific skills, readiness as a function of meanings and values defined by the child’s

school and community, or a combination of children's abilities and the school's capacity to adapt to meet their needs. This last interpretation most closely aligns with the intentions and goals of WaKIDS. According to this perspective, readiness goes both ways: A child's activity can alter the environment in which the child is learning as much as the environment can influence what the child is able to accomplish. This theory calls on schools and educators to continuously adapt their teaching environments to meet students' transforming needs.

The Importance of Early Skills in Developmental Areas Typically Associated with School Readiness

Both cognitive and noncognitive skills help children adapt to the school environment and engage in learning. The development of these skills, both at home before kindergarten and in the classroom, is an essential building block for future achievement. For example, procedural and conceptual math knowledge is important, as opposed to only rote memorization, because it allows children to apply their understanding of basic math procedures and logic to problem solve and reason through more abstract and advanced topics in later years, including even Algebra and Geometry (Baroody, 2003; Hiebert and Wearne, 1996).

Similarly, pre-literacy and language building blocks are critical for developing reading skills. For example, language comprehension is made up of background knowledge, vocabulary, language structures, verbal reasoning and literacy knowledge, whereas word recognition consists of phonological awareness, decoding and sight recognition skills. Together, these two abilities form the basis for strong reading ability (Catts et al., 2016; Scarborough, 2001; Storch and Whitehurst, 2002). In a meta-analysis of studies that predicted later reading achievement from kindergarten-entry literacy indicators, on average, letter recognition and phonological awareness were highly correlated with later reading ability (Scarborough, 2001). Exposure to more sophisticated vocabulary and analytical discussion in preschool can also help students develop a stronger foundation for reading (Dickinson and Porche, 2011).

Social-emotional and physical skills are examples of noncognitive abilities that also play a role in school readiness. Social behavior and emotional intelligence impact students' abilities to form positive relationships with peers and teachers when entering school, which subsequently influences their likelihood to participate and achieve (Ladd et al., 1999; McCormick et al., 2013; Pianta and Stuhlman, 2004; Raver, 2002). Similarly, the ability to persist, regulate emotions, and focus in kindergarten may contribute to positive or negative feedback loops that can help reinforce a child's self-motivation and curiosity or become a barrier to learning (Li-Grining et al., 2010; McClelland et al., 2000; Raver, 2002). Multiple literature reviews have found that regular physical activity is not only tied to positive health outcomes, but is also associated with improved cognitive function, test scores and classroom behavior in children (Singh et al., 2012; Trudeau and Shephard, 2008).

Substantial research by James J. Heckman (2011) has also shown that investing in early education contributes to positive social and economic rates of return later in life for both the individual and society. This is particularly the case among disadvantaged children, where quality early education can help overcome environmental risk factors and reduce opportunity gaps.

Does School Readiness Predict Later Achievement?

Numerous studies have demonstrated that math ability at school-entry predicts later math achievement (ASR, 2018; ASR, 2010; Bodovski and Farkas, 2007; Claessens et al., 2006; Claessens and Engel, 2013; Crosnoe et al., 2010; Duncan et al., 2007; Harding et al., 2019; Hierbert and Wearne, 1996; Jordan et al., 2009; La Paro and Pianta, 2000; Pace et al., 2018; Pagani et al., 2010; RAND, 2006; Stevenson and Richard, 1986). For example, kindergarten number competence predicted math skill growth rates from 1st through 3rd grade and achievement levels in 3rd grade (Jordan et al., 2009). Similarly, researchers used nationally representative Early Childhood Longitudinal Study (ECLS) data to determine that pattern recognition, measurement and advanced numbers were the kindergarten math skills most predictive of 8th grade math achievement (Claessens and Engel, 2013).

Likewise, early literacy ability predicts reading achievement in later years (ASR, 2018; ASR, 2010; Claessens et al., 2006; Claessens and Engel, 2013; Duncan et al., 2007; Harding et al., 2019; La Paro and Pianta, 2000; Pace et al., 2018; Pagani et al., 2010; RAND, 2006; Scarborough, 2001; Stevenson and Richard, 1986; Storch and Whitehurst, 2002). Many of these same studies have also demonstrated that the two subjects are interlinked, and that early math skills are predictive of later reading achievement and vice versa. (ASR, 2018; ASR, 2010; Claessens et al., 2006; Claessens and Engel, 2013; Duncan et al., 2007; Duncan and Magnuson, 2011; Harding et al., 2019; La Paro and Pianta, 2000; Pace et al., 2018; Pagani et al., 2010; RAND, 2006; Stevenson and Richard, 1986).

A growing number of studies have also identified associations between early social-emotional skills including attention, behavior, and self-regulation and later academic achievement (ASR, 2018; ASR, 2010; Brock et al., 2009; Claessens et al., 2006; Duncan et al., 2007; Harding et al., 2019; Li-Grining et al., 2010; McCormick et al., 2013; Pace et al., 2018; Pagani et al., 2010; Pianta and Stuhlman, 2004; RAND, 2006; Sabol and Pianta, 2012). However, social-emotional predictors tend to be weaker or rendered insignificant when early cognitive skills are also controlled for (Claessens et al., 2006; Duncan et al., 2007; Harding et al., 2019; LaParo and Pianta, 2000). But this is not always the case. For example, using sample data from the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (NICHD SECCYD), Sabol and Pianta (2012) identified six school readiness profiles based on kindergarten social and executive functioning and found them to be predictive of differences in 5th grade math, reading and social-emotional ability even after controlling for demographics and environmental factors. Skills such as high social competence and working memory were especially strong predictors. Fine motor skills have also been shown to predict academic outcomes, even when controlling for early cognitive abilities (Grissmer et al., 2010; Pagani et al., 2010).

A meta-analysis of 70 longitudinal studies found moderate effect sizes for kindergarten cognitive skills predicting 1st and 2nd grade cognitive outcomes and found small effect sizes for kindergarten social and behavior skills predicting social and behavioral outcomes in later years (La Paro and Pianta, 2000). Additionally, in one of the most comprehensive longitudinal analyses to date of school-entry skills and later academic outcomes, Duncan et al. (2007) used six

longitudinal data sets¹ to determine that school-entry math, reading and attention skills were the strongest predictors of later math and reading achievement in 3rd–5th grade. School-entry social-emotional behaviors were rarely significant predictors.

Two California studies used kindergarten-entry assessment data and 3rd grade Smarter Balanced Assessment (SBA) test scores in math and ELA to assess whether kindergarten readiness in cognitive and social-emotional domains was predictive of later academic achievement (ASR, 2018; ASR, 2010). In both studies, the strongest predictors of 3rd grade SBA performance were kindergarten cognitive (e.g. math, literacy) and self-regulation skills (e.g. ability to persist, regulate emotions, focus). The Alameda County study found that kindergarten-entry skills continued to be strong predictors of SBA performance in 4th through 6th grade. Other significant predictors included health, English proficiency, socioeconomic status and regular attendance in Alameda County, and race/ethnicity and socioeconomic status in Santa Clara and San Mateo Counties.

In both studies, students were more likely to “fall behind” and not meet 3rd grade SBA standards even if they were kindergarten-ready if they were Multilingual/English learners or from low-income families. In Alameda County, they were also more likely to be male, whereas in Santa Clara and San Mateo Counties, students were also more likely to also be younger, Hispanic/Latino and have mothers with lower education levels. In both studies, students were more likely to “beat the odds” and meet 3rd grade SBA standards even if they hadn’t been kindergarten-ready if they were older. In Alameda County, the families of students who “beat the odds” also had greater access to community resources during kindergarten. In Santa Clara and San Mateo Counties, students who “beat the odds” were also more likely to be Asian/Caucasian, upper-income, and have mothers with higher education levels.

Similarly, the School District of Philadelphia analyzed the relationship between their students’ kindergarten-entry assessment results and 3rd grade state standardized test scores in math and ELA (Harding et al., 2019). They found that when the math and literacy dimensions and the behavioral and motor dimensions of the kindergarten assessment were regressed separately, both predicted 3rd grade math and ELA performance. However, when the math, literacy, behavioral and motor dimensions were regressed together, only the math and literacy dimensions remained significant, suggesting that early math and literacy skills were more powerful predictors.

Opportunity Gaps in School Readiness

While kindergarten readiness predicts later academic outcomes, not all students enter kindergarten with the same level of skills. Social and economic policies have created barriers for communities of color to access resources that promote school readiness. These inequities due to

¹ Data sets used: The Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K), National Longitudinal Study of Youth (NLSY), National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (NICHD SECCYD), Infant Health and Development Program (IHDP), Montreal Longitudinal Experimental Preschool Study (MLEPS) and the British Birth Cohort Study (BCS).

racism can compound over generations (Lee and Burkam, 2002; Walker et al., 2011; Zill, 1999).

Nearly all studies on the subject have found that White and Asian students receive higher marks on math, literacy, vocabulary, and social-emotional skills at kindergarten-entry than their peers from other racial and ethnic backgrounds (Coley, 2002; Fryer and Levitt, 2004; Fryer and Levitt, 2006; Garcia and Weiss, 2017; Lee and Burkam, 2002; Reardon and Portilla, 2016; Rumberger and Anguiano, 2004; Sadowski, 2006). Similarly, students from middle- and higher-income families tend to enter school with higher skill levels and score higher on achievement tests in early elementary than students from low-income families (Buchinal et al., 2011; Coley, 2002; Entwisle and Alexander, 2002; Garcia and Weiss, 2017; Gershoff et al., 2007; Jordan et al., 1992; Lee and Burkam, 2002; Sadowski, 2006; Reardon and Portilla, 2016; Zill, 1999).

Development in early years is not only dependent upon innate ability but also upon resources and stability available in the child's household and community environment (Bronfenbrenner and Morris, 1998; Cunha et al., 2005). For example, one study found that children from low-income families are read to less frequently by parents and are less likely to be enrolled in early learning programs before kindergarten (Zill, 1999). Similarly, in another study, students who did well on verbal addition and subtraction tasks as opposed to nonverbal tasks were overwhelmingly from middle- and higher-income families and used finger counting techniques that were not taught in the classroom and probably acquired at home (Jordan et al., 1992). Additionally, differences in parents' education or cultural backgrounds may contribute to children's varying levels of acculturation to the dominant social and academic expectations present in the classroom. (Entwisle and Alexander 2002; Ladd et al., 1999).

Children from families experiencing socioeconomic hardship are also more likely to live in unstable environments and experience more frequent and severe disruptions (Bronfenbrenner and Morris, 1998; Walker et al., 2011). These disruptions, or external stressors, can interfere with the brain's development and cognitive processing, which is critical at an early age. When stressors trigger the release of cortisol in the brain, cognitive functioning involving learning, problem-solving and creative thinking is inhibited (Walker et al., 2011). Often, it is the compounding of multiple factors in a child's household and community that impact their cognitive and social-emotional development from an early age and contribute to school readiness gaps (Sameroff and Fiese, 2000; Walker et al., 2011).

What Happens to Opportunity Gaps as Students Move Through Elementary School?

Racial/ethnic and socioeconomic opportunity gaps that are present at kindergarten-entry, particularly the Black-White gap, generally persist or widen over time as students move through elementary school (Burchinal et al., 2011; Duncan and Magnuson, 2011; Fryer and Levitt, 2004; Fryer and Levitt, 2006; Jordan et al., 2009; LoGerfo and Nichols, 2006; Murnane et al., 2006; Rathbun and West, 2004; Rumberger and Anguiano, 2004).

In one of the most widely cited analyses of the Black/African American-White opportunity gap, Levitt and Fryer (2004; 2006) used nationally representative ECLS data to conclude that gaps in

reading and math ability continued to widen from kindergarten through 3rd grade at an average rate of $-.10$ standard deviations per year within the same schools, and even within the same classrooms as their White peers. In other words, differences between schools and classrooms did not explain the gap. The largest gaps were in multiplication and division, and reading inference, extrapolation and evaluation, skills that form the foundation of more advanced concepts that students learn in later years. They also found that the Hispanic/Latino-White gap narrowed, suggesting that while Hispanic/Latino students may share some of the same socioeconomic circumstances as Black/African American students, but Black/African American students face unique systemic barriers.

Regarding gender, one study using ECLS data found no gender gap at kindergarten-entry in math except among top-ability students, but noted that female students lost ground in elementary and regained some of it in middle school (Robinson and Lubienski, 2011). Additionally, in reading, opportunity gaps that favored female students narrowed except for among students who received low scores, where it widened.

According to two Applied Survey Research studies conducted in California, between kindergarten-entry and 3rd grade, Alameda County identified widening gaps in reading and math abilities among students who were from low-income families, Black/African American, and Hispanic/Latino (only in ELA) students. By 3rd grade, a reading gap for Multilingual/English learners emerged, while the gender gap disappeared. Students who narrowed the gap, or “beat the odds” were more likely to attend schools that had fewer students from low-income families and had higher average math SBA performance. Opportunity gaps widened between socioeconomically advantaged and disadvantaged students and between Asian/White and Hispanic/Latino students (ASR, 2018; ASR, 2010).

Kindergarten Readiness and Later Academic Achievement in Washington State

Kindergarteners in Washington enter school with varying levels of math, literacy, language, cognitive, social-emotional, and physical abilities, as measured by the Washington Kindergarten Inventory of Developing Skills assessment (WaKIDS) (Report Card, 2020). Aforementioned literature demonstrated developmental or skill level inequities at school-entry along socioeconomic and racial/ethnic lines and Washington is no exception. A larger proportion of students who are Asian, White, native English speakers, from middle- or higher-income families, not experiencing homelessness, not migratory, and without disabilities were ready in all six WaKIDS readiness domains compared to their peers (Report Card, 2020).

While there is limited research on school readiness gaps in Washington, existing findings align with those identified by the literature previously discussed. Using WaKIDS data for kindergarten cohorts from 2012–13, 2013–14, and 2014–15, student-level factors including gender, Hispanic/Latino ethnicity, Multilingual/English Learner (M/EL) status, and income were found to be predictive of the number of domains a student was kindergarten-ready (Blodgett and Houghten, 2018). There were significant readiness gaps by income and M/EL status in each specific domain. Significant readiness gaps were also present between genders in all domains

except math and literacy, and by Hispanic/Latino ethnicity in all domains except physical and social-emotional. Significant school-level characteristics predicting the percent of students being kindergarten-ready in all six domains included the percent of students from low-income families, who were Multilingual/English learners, or who identified as Hispanic/Latino.

Within Washington State, there has also been limited research on the predictive value of kindergarten readiness on later academic achievement. However, the same report referenced above included an exploratory analysis of associations between WaKIDS and 3rd grade SBA results and found small to moderate correlations. Further, gender, M/EL status, school poverty, Hispanic/Latino ethnicity, number of WaKIDS domains school-ready in, and all WaKIDS domain scale scores except for the physical domain were significant predictors (Blodgett and Houghten, 2018). However, the authors acknowledge that these conclusions are preliminary, partially because at the time of the study, SBA data was only available for the 2012–13 kindergarten cohort and WaKIDS was not yet fully implemented statewide. Nevertheless, these initial findings suggest a significant relationship between early skill sets and 3rd grade achievement.

Existing findings indicate that gaps in kindergarten readiness and its relationship to later achievement in elementary school in Washington align with those found at the national level. However, further investigation is necessary to better understand the predictive relationship between specific WaKIDS domains and 3rd grade math and ELA SBA outcomes, as well as how opportunity gaps between student groups change over time.

RESEARCH QUESTIONS

- 1) How does kindergarten readiness and 3rd grade SBA proficiency vary by student group?
- 2) Are there significant opportunity gaps in literacy and math at kindergarten among student groups? What happens to these gaps by 3rd grade?
- 3) Of students who were kindergarten-ready in literacy and math, are certain student groups not meeting 3rd grade SBA standards?
- 4) Does kindergarten readiness predict 3rd grade math and ELA SBA proficiency?

DATA

Primary Independent Variables: WaKIDS Kindergarten Readiness

WaKIDS is a tool used to support educators, families and students through the transition into kindergarten. It includes an assessment of students' developmental skill levels based on age-appropriate expectations in six domains: social-emotional, physical, language, cognitive development, literacy, and math. While WaKIDS consists of three components including Family Connection, Whole-child Assessment and Early Learning Collaboration, this analysis focuses solely on the observational assessment portion. Washington State utilizes a custom version of the Teaching Strategies GOLD® assessment which uses a subset of 31 of the 38 original

objectives (OSPI, 2019). For each objective, educators observe a student and identify where that student falls on a developmental continuum based on examples of demonstrable age-appropriate skills from birth through third grade. A student is deemed kindergarten-ready in each domain if their observed behavior falls within the indicator immediately preceding the purple band, indicating the skill level expected of a kindergartener. Kindergarten readiness is based on whether a student is kindergarten-ready in all six domains.

WaKIDS was piloted in 2010–11, became mandatory in state-funded, full-day kindergarten in 2012–13, and was scaled up incrementally each succeeding year. As WaKIDS was rolled out, schools with higher proportions of students eligible for Free and Reduced-Price Meals were prioritized. WaKIDS was fully implemented in 2017–18, however, SBA results will not be available until this cohort reaches 3rd grade in 2020–21. While not all kindergarteners participated in WaKIDS in 2015–16 and students from low-income families are likely overrepresented, this data set represents the most complete and recent sample where 3rd grade SBA data is available.

This analysis uses binary indicators based on whether the student was kindergarten-ready in each 2015–16 fall WaKIDS domain (literacy, math, cognitive, language, social-emotional, physical) and overall (readiness in all six domains).

Additional Independent Variables:

The following variables were also included to examine differences in performance between groups and assess whether kindergarten readiness remained a significant predictor after controlling for student-level characteristics.

Gender: Male or female.²

Race/Ethnicity: Students were categorized into racial/ethnic categories based on federal reporting standards: American Indian/Alaskan Native, Asian, Black/African American, Hispanic/Latino of any race(s), Native Hawaiian/Other Pacific Islander, Two or more races, and White.

Multilingual/English learner (M/EL): Students whose primary or home language is a language other than English and who received M/EL services at any point in the school year were included in this measure.

Income: Free and/or Reduced-Price Meal (FRPM) eligibility at any point in the school year was used to indicate whether the student was from a low-income family. Because research has shown that the effect of poverty can compound over time, income status was operationalized as a continuous measure to indicate the number of years between kindergarten and 3rd grade that a student was eligible for FRPM.

Students with disabilities (SWD): Students with disabilities who had an Individual Education

² While the male/female dichotomy may be better described as “biological sex”, the term “gender” is used in this report to align with current OSPI public reporting language, while also acknowledging that gender is a social construct.

Program (IEP) and received special education services at any point in the school year were included in this measure.

Regular attendance: Regular attendance was defined as having, on average, less than two absences a month. Only students who were enrolled for at least 90 days in the school year were included in this measure. This variable was also operationalized as a continuous measure to indicate the number of years students had regular attendance between kindergarten and 3rd grade to account for the compounding effect of routinely missing classroom instruction.

Discipline: Students who were suspended (short-term or long-term) or expelled (normal or emergency) at any point during the school year were included in this measure.

Learning Assistance Program (LAP): LAP offers supplemental services to students who score below grade-level standards in ELA and math. Students were included in this measure if they received LAP services at any point during the school year.

School mobility: School mobility indicates how many times students were enrolled in distinct schools between kindergarten and 3rd grade. More than two school changes in this period is assumed to indicate a level of instability that may impede learning, compared to one or zero.³

Dependent Variable: 3rd Grade SBA Proficiency

The SBA is a summative assessment in ELA and math, first administered in third grade. The assessment is designed to measure students' progress toward college and career readiness and consists of a computer adaptive test and a performance task (OSPI, 2019). This analysis operationalizes the outcome variable as a binary indicator for each subject based on whether students met 3rd grade SBA standards in 2018–19.

METHODOLOGY

Descriptive statistics were used to compare the matched cohort student demographics with those of all full-time kindergarteners in 2015–16 and all 3rd graders in 2018–19 to determine if the matched cohort was representative. Next, WaKIDS readiness and 3rd grade SBA results were summarized. Chi-square tests were used to determine if the proportion of students who were kindergarten-ready in each domain and met ELA and math SBA standards differed significantly by student group.

To analyze whether opportunity gaps within student groups persisted, narrowed, or widened

³ In regressions gender, M/EL status, SWD status, discipline, and LAP status are based on 3rd grade 2018-19 school year data and are coded dichotomously with the following reference groups: male, native English speaker, student without disability, no suspension/expulsion, didn't receive LAP services. Race/Ethnicity is based on 3rd grade data with White students as the reference group. The reference group for school mobility is zero school changes. Indicators for income and regular attendance for the specified year (e.g. kindergarten or 3rd grade) are also included in descriptive statistics and figures for those who want to directly compare differences in performance at that time point. However, in regressions, income and regular attendance are coded continuously as the number of years a student was eligible for FRPM or had regular attendance with zero years as the reference group for both.

from kindergarten to 3rd grade, literacy and math WaKIDS scale scores and math and ELA SBA scale scores were centered and converted to z-scores. This method allows one to directly compare test performance, even if the tests used different scoring scales. T-tests were used to identify when there were significant differences in average z-scores between student groups in both kindergarten and 3rd grade, and whether these opportunity gaps persisted, narrowed or widened over time. However, a statistically significant difference does not necessarily equate to a practical difference in real-world application.

Special attention was given to identifying students who entered kindergarten with strong skills in literacy and math but did not meet ELA and math SBA standards in 3rd grade. Chi-square tests were used to determine if a significantly disproportionate number of students who didn't meet 3rd grade standards belonged to particular student groups.

Finally, separate multilevel logistic regressions were used to predict 3rd grade ELA and math SBA proficiency based on kindergarten readiness and other student-level factors. Multilevel models are appropriate when subjects (e.g. students) are nested within hierarchical structures (e.g. schools). This technique controls for the shared variation within clusters. For example, two students in the same school may both be influenced by an unobservable factor specific to their particular school that affects their SBA performance, whereas a student attending a different school might not be. As a consequence, there may be less variation in SBA outcomes within a cluster (e.g. school). Multilevel modeling helps differentiate the extent to which variation in the outcome variable is attributable to either student-level characteristics or school-level factors.

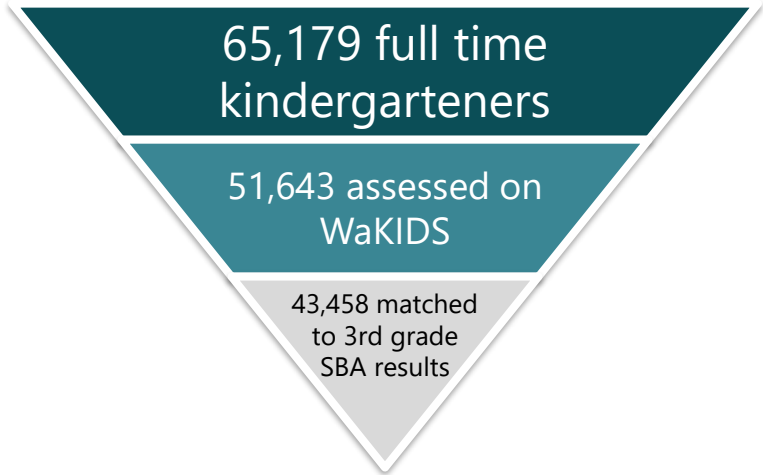
First, models only included kindergarten readiness by WaKIDS domains and overall readiness. Next, race/ethnicity and gender were included under the assumption that these remained largely constant from kindergarten to 3rd grade. Finally, post-kindergarten student-level variables (e.g. M/EL status) were incorporated. At each stage, models were assessed for goodness of fit.

RESULTS

Cohort Demographics and Characteristics

In 2015–16, 65,179 students were enrolled in full time kindergarten. Of those, 51,643 (79%) were assessed on WaKIDS in the fall. 43,458 (84%) of WaKIDS kindergarteners were matched to 3rd grade SBA records. The limited match rate could be explained by factors such as students moving out of state or opting out of the SBA in third grade.

Figure 1: Sample Attrition



Tables 1 and 2 present student counts for the matched cohort at kindergarten and 3rd grade compared to all full-time kindergarteners in 2015–16 and all 3rd graders in 2018–19.

In comparison to all full-time kindergarteners in 2015–16, there was no significant difference in the proportion of matched cohort students who were American Indian/Alaskan Native, Black/African American, Native Hawaiian/Other Pacific Islander, Two or More Races, and had been suspended or expelled. Some more noticeable differences include students who were Hispanic/Latino, Multilingual/English learners, from low-income families, without disabilities, attending school regularly, and receiving LAP services being overrepresented in the matched cohort compared to all full-time kindergarteners. Likewise, students who were Asian, White, native English speakers, from middle- or higher-income families, with disabilities, not attending school regularly, and not receiving LAP services were underrepresented.

There were more differences when comparing the matched cohort’s 3rd grade demographic and student group counts to all 3rd graders in 2018–19. There were significant differences in the proportion of students belonging to each group except for Native Hawaiian/Other Pacific Islanders and students of Two or More Races. In comparison to all 3rd graders, the matched cohort had more American Indian/Alaskan Native students, fewer Black/African American students and more students who had been suspended or expelled. The matched cohort also appeared to have fewer students who changed schools frequently, and more students who were from low-income families and had regular attendance for more years.

These differences indicate that the matched cohort is not entirely representative of the 2015–16 statewide full-time kindergarten cohort, nor all statewide 3rd graders in 2018–19. This was expected given that WaKIDS was not fully implemented statewide in 2015–16 and the roll-out prioritized schools with higher proportions of students from low-income families. Consequently, generalizing conclusions to the wider student population beyond the current sample may not be appropriate.

Table 1: Comparing Kindergarten Demographics and Student Group Counts

	Matched Cohort (n = 43,458)	All Full time 2015 16 Kindergarteners (n = 65,179)
Gender		
Female	49.3%	48.4%**
Male	50.7%	51.6%**
Race/ethnicity		
American Indian/Alaskan Native	1.5%	1.5%
Asian	4.7%	6.6%***
Black/African American	3.7%	3.9%
Hispanic/Latino of any race(s)	30.6%	26.9%***
Native Hawaiian/Other Pacific Islander	1.1%	1.1%
Two or More Races	8.5%	8.7%
White	50.0%	51.3%***
Multilingual/English learners	24.8%	22.6%***
Non-Multilingual/English Learner	75.2%	77.4%***
Students from low-income families	58.8%	53.3%***
Students from not low-income families	41.2%	46.7%***
Students with disabilities	10.4%	12.2%***
Students without disabilities	89.6%	87.8%***
Marked as regularly attending	83.0%	79.1%***
Not marked as regularly attending	15.9%	16.6%***

Suspended or expelled	1.8%	1.8%
Not suspended or expelled	98.2%	98.2%
Received LAP services	32.5%	29.2%***
Did not receive LAP services	67.5%	70.8%***

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$ compared to matched cohort.

Table 2: Comparing 3rd Grade Demographics and Student Group Counts

	Matched Cohort (n = 43,458)	All 2018 19 3rd Graders (n = 86,500)
Gender		
Female	49.3%	48.7%*
Male	50.7%	51.3%*
Race/ethnicity		
American Indian/Alaskan Native	1.4%	1.2%**
Asian	4.6%	7.8%***
Black/African American	3.7%	4.3%***
Hispanic/Latino of any race(s)	30.5%	24.1%***
Native Hawaiian/Other Pacific Islander	1.1%	1.2%
Two or More Races	8.9%	9.2%
White	49.7%	52.1%***
Multilingual/English Learners	17.1%	15.1%***
Non-Multilingual/English Learners	82.9%	84.9%***
Students from low-income families	59.9%	49.3%***
Students from not low-income families	40.1%	50.7%***
Students with disabilities	14.3%	15.6%***
Students without disabilities	85.7%	84.4%***
Marked as regularly attending	88.8%	87.4%***

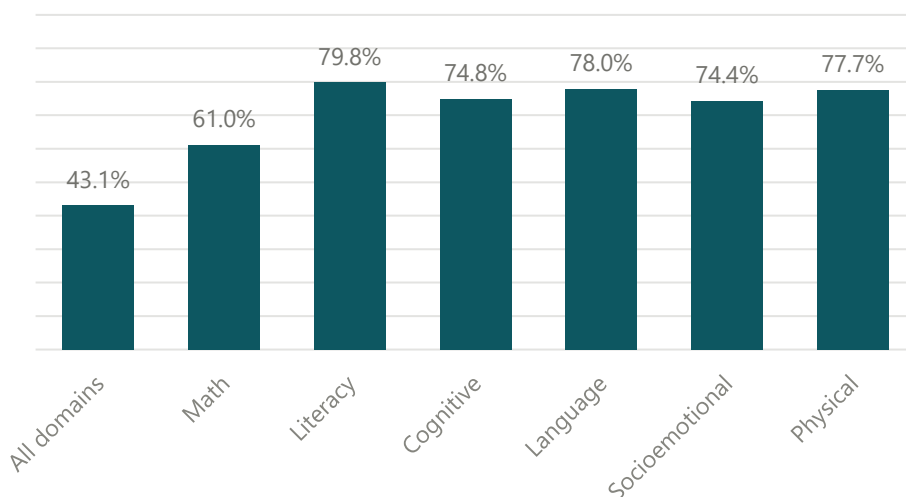
	Matched Cohort (n = 43,458)	All 2018 19 3rd Graders (n = 86,500)
Not marked as regularly attending	11.0%	10.6%*
Suspended or expelled	1.9%	1.7%**
Not suspended or expelled	98.1%	98.3%**
Received LAP services	30.2%	24.5%***
Did not receive LAP services	69.8%	75.5%***
Mobility (number of school changes)		
0	59.8%	38.0%***
1	30.8%	47.7%***
2+	9.5%	14.3%***
Number of years student was eligible for FRPM		
0	33.2%	45.1%***
1	2.9%	5.3%***
2	5.5%	7.1%***
3	8.8%	13.8%***
4	49.6%	28.7%***
Number of years student had regular attendance		
0	2.8%	4.6%***
1	4.1%	8.7%***
2	7.4%	12.0%***
3	16.1%	30.7%***
4	69.7%	43.9%***

***p < 0.001 **p < 0.01 *p < 0.05 compared to matched cohort.

2015–16 WaKIDS Performance

A little less than half of the matched cohort was kindergarten-ready in all six domains (Figure 2). However, within most individual domains, about three-fourths of students demonstrated skills associated with kindergarten readiness. Students were least prepared in math.

Figure 2: 2015-16 WaKIDS Kindergarten Readiness Results for Matched Cohort



Differences in Kindergarten Readiness Between Student Groups

Kindergarten readiness in math, literacy, cognitive, language, social-emotional, and physical skills, as well as overall kindergarten readiness in all six domains, was significantly associated with race/ethnicity, M/EL status, income, SWD status, regular attendance, discipline and LAP status (Figures 3–10). There were also significant differences in kindergarten readiness by gender, except in math.

Asian and White students were more likely to be kindergarten-ready overall, and in each domain, compared to their peers. The largest gap between the highest and lowest readiness was in math. 70.2% of White students were kindergarten-ready in math, compared to only 44.5% of Hispanic/Latino students and 44.7% of Native Hawaiian/Other Pacific Islander students. There were smaller gaps in social-emotional and physical skills. For example, 76.4% of White students were kindergarten-ready in social-emotional skills, compared to 74% of Hispanic/Latino students.

Overall, more students who were female, native English speakers, from middle- and higher-income families, without disabilities, regular attenders, who hadn't been suspended or expelled, and didn't receive LAP services were kindergarten-ready in each domain and in all six compared to their peers.

Figure 3: Kindergarten Readiness by Race/Ethnicity

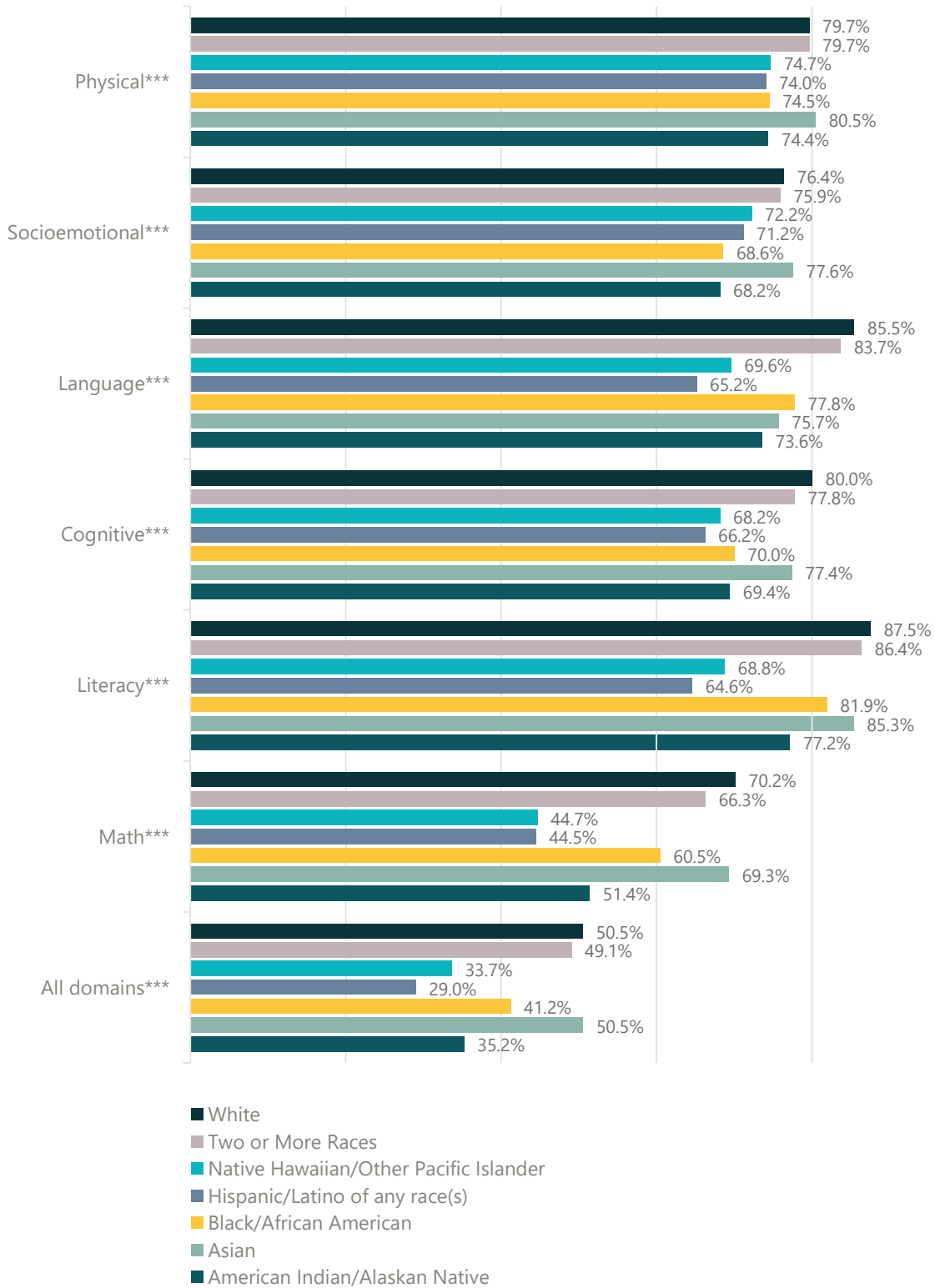


Figure 4: Kindergarten Readiness by Gender

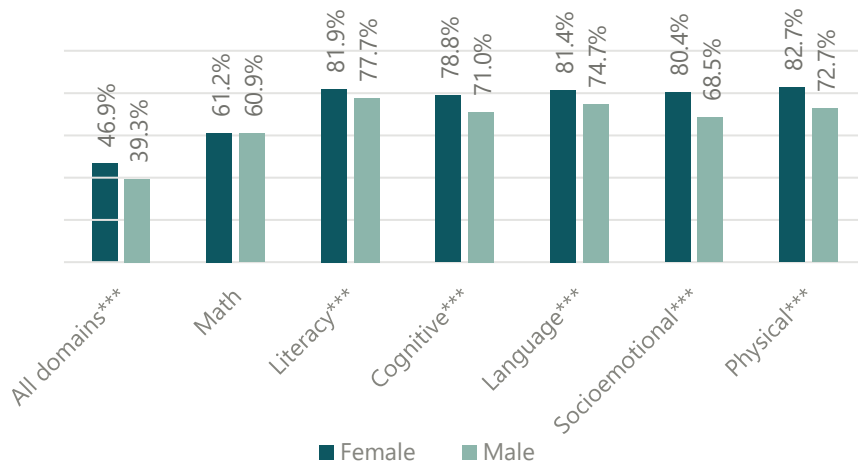


Figure 5: Kindergarten Readiness by Multilingual/English Learner Status

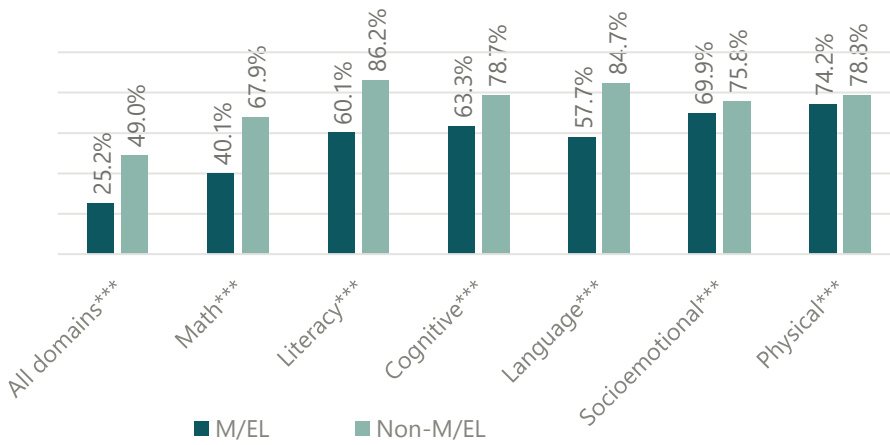


Figure 6: Kindergarten Readiness by Income

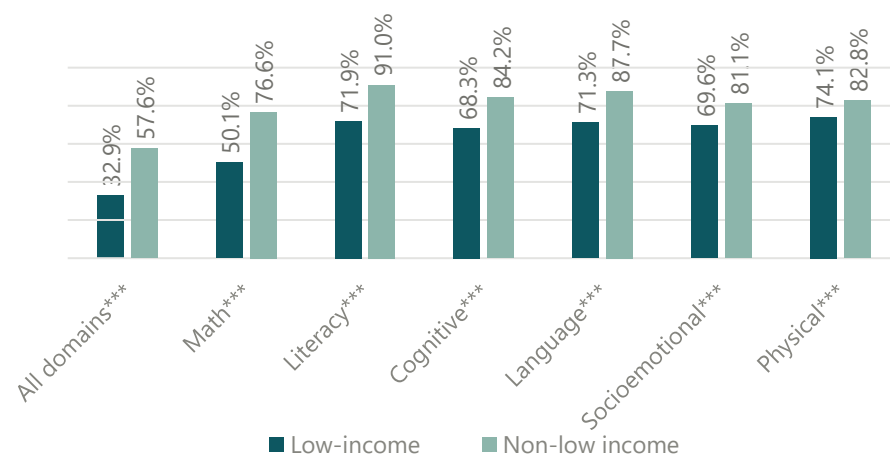


Figure 7: Kindergarten Readiness by SWD Status

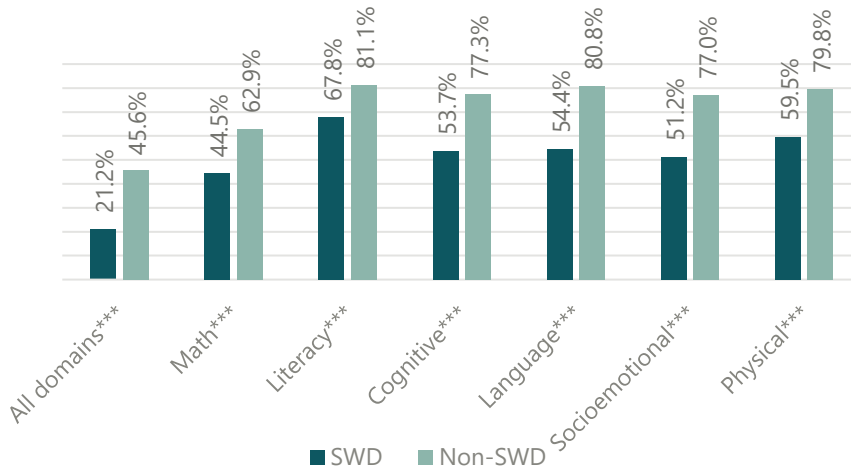


Figure 8: Kindergarten Readiness by Regular Attendance

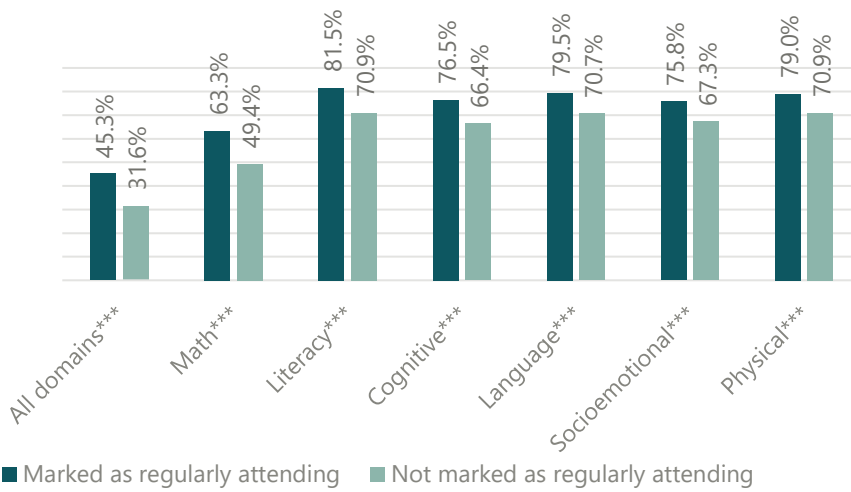


Figure 9: Kindergarten Readiness by Discipline Incidence

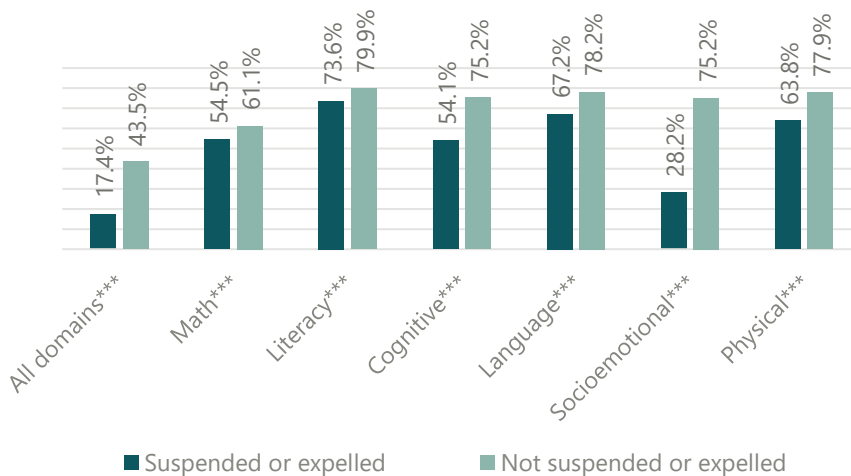
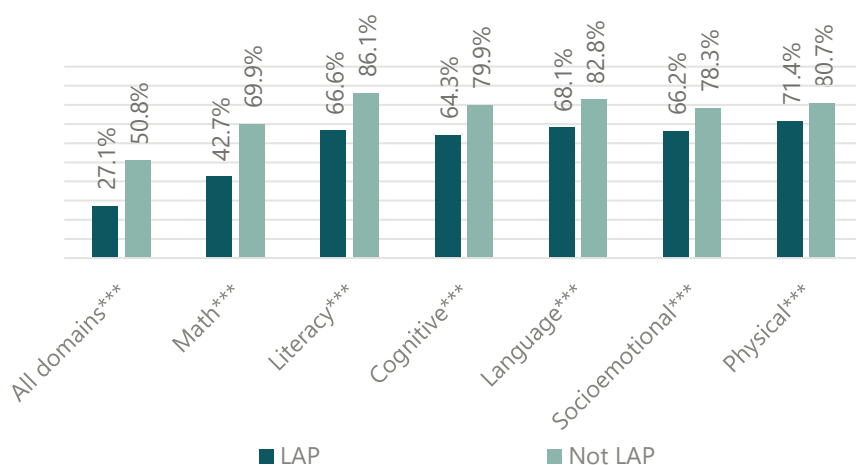


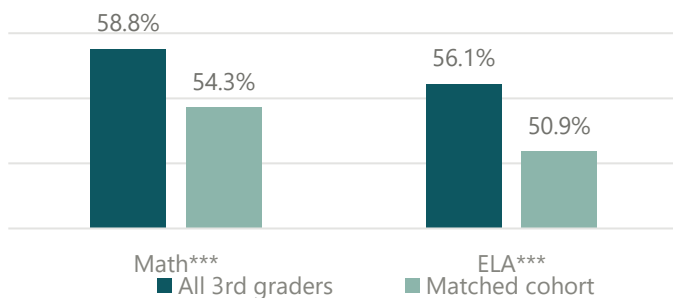
Figure 10: Kindergarten Readiness by LAP Status



2018–19 3rd Grade SBA Performance

Slightly more than half of the matched cohort met standard on the 3rd grade SBA (Figure 11). Compared to the SBA performance of all 3rd graders in Washington in 2018–19, the matched cohort’s results were significantly lower in each subject. This may be explained by the larger proportion of students from low-income families in the WaKIDS sample since students from low-income families generally have less access to resources outside of the classroom than their more affluent peers.

Figure 11: All 2018-19 3rd Graders and Matched Cohort Who Met SBA Standards



Differences in SBA Performance Between Student Groups

Within the matched cohort, 3rd grade math and ELA SBA proficiency was statistically significantly associated with gender, race/ethnicity, M/EL status, income, SWD status, regular attendance, discipline, LAP status, school mobility, the number of years a student qualified for Free and Reduced Price Lunch and had regular attendance (Figures 12–22). Male students were more likely to be proficient in math, and female students were more likely to be proficient in ELA. As in kindergarten readiness, students who were not Multilingual/English learners, not from

low-income families, without disabilities, marked as regularly attending, had not been suspended or expelled, and didn't receive LAP services were more likely to meet standard. Likewise, opportunity gaps between Asian/White and non-Asian/White student groups persist, if not widen. For example, 70.2% of Asian students met standard in math and 63.6% met standard in ELA, compared to the lowest performing group, American Indian/Alaskan Native students, of whom only 33.5% and 27.9% met standard. Living in a low-income household or not having regular attendance for multiple years appears to greatly decrease students' chances of meeting SBA standards (Figures 22–23).

Figure 12: SBA Proficiency by Race/Ethnicity

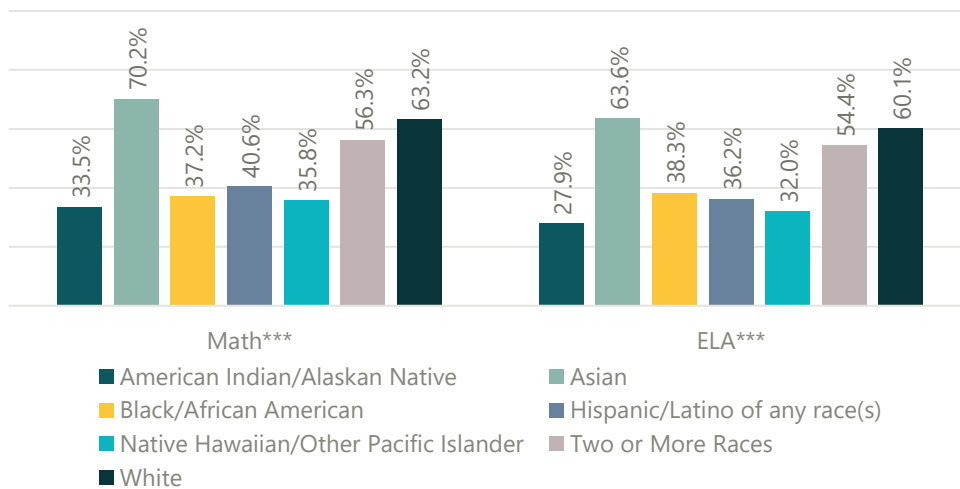


Figure 13: SBA Proficiency by Gender

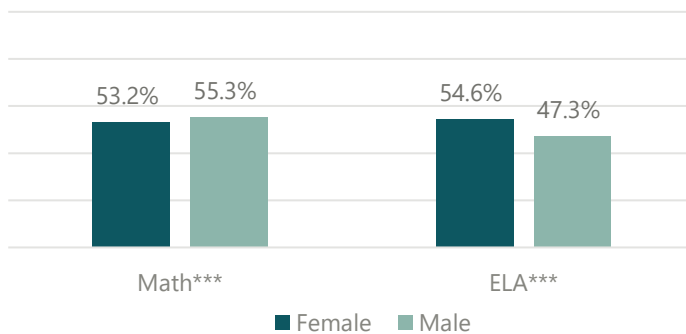


Figure 14: SBA proficiency by M/EL status

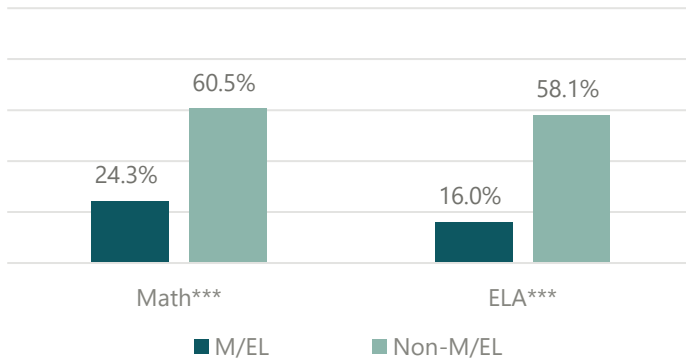


Figure 15: SBA Proficiency by Income

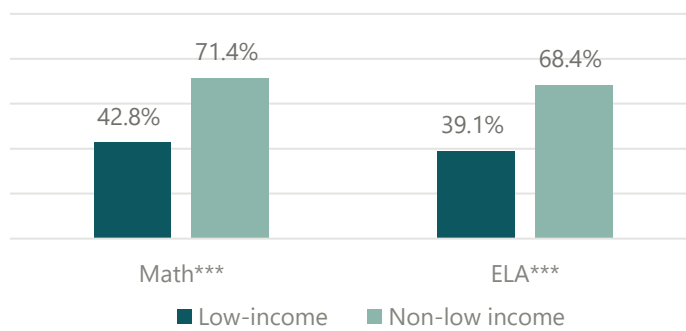


Figure 16: SBA Proficiency by SWD Status

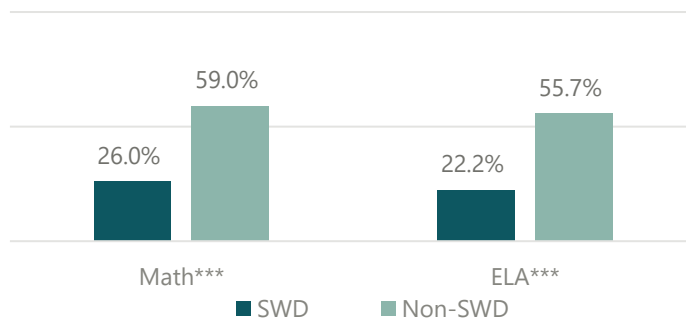


Figure 17: SBA Proficiency by Regular Attendance

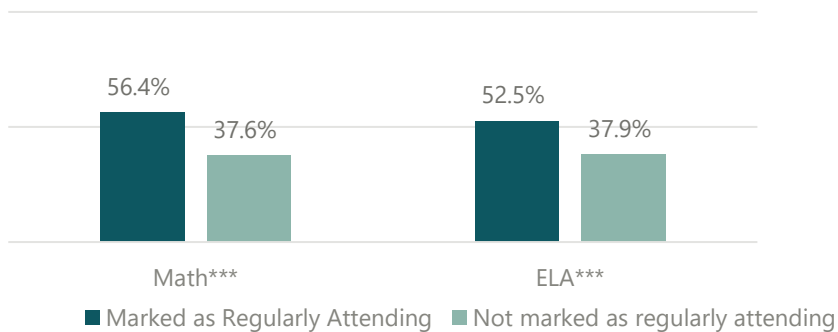


Figure 18: SBA Proficiency by Discipline Incidence

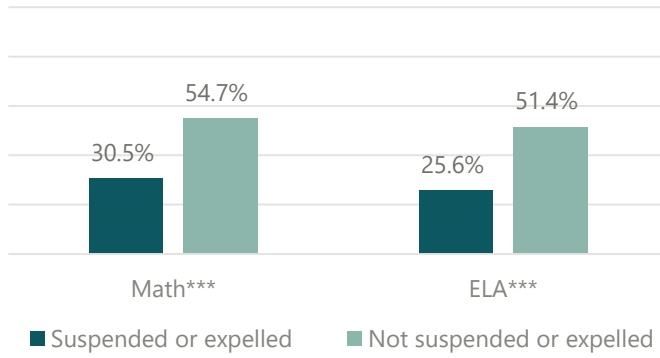


Figure 19: SBA Proficiency by LAP Status

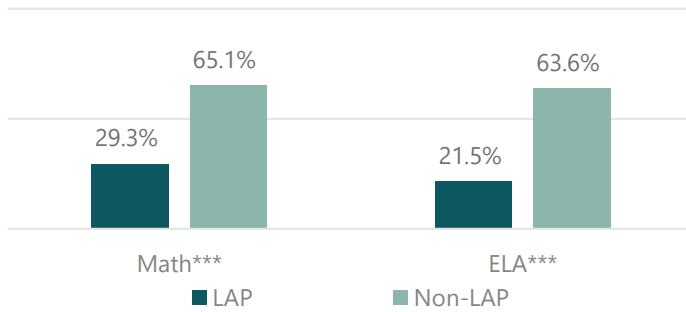


Figure 20: SBA Proficiency by School Mobility

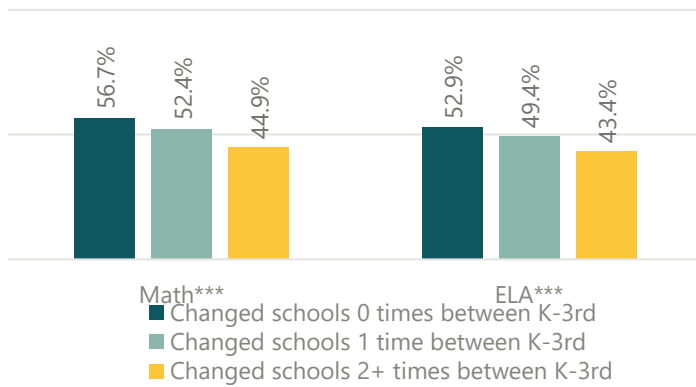


Figure 21: SBA Proficiency by Number of Years Eligible for FRPM

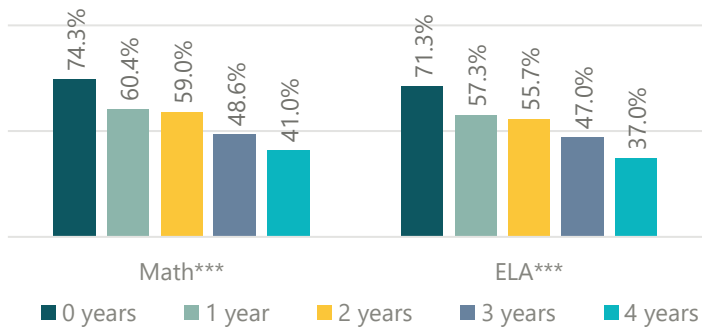
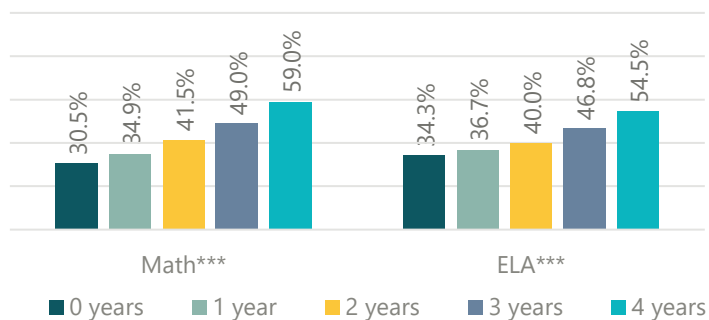


Figure 22: SBA Proficiency by Number of Years Regular Attendance



Opportunity Gaps in Kindergarten and 3rd Grade

To analyze whether opportunity gaps within student groups persisted, narrowed or widened from kindergarten to 3rd grade, literacy and math WaKIDS scale scores and math and ELA SBA scale scores were centered and converted to z-scores. In this case, a z-score indicates how many standard deviations away from the mean of the matched cohort a student scored. A positive z-score indicates an above average score, while a negative z-score indicates a below average score. However, positive or negative z-scores should not be necessarily interpreted as an indicator of kindergarten readiness or meeting SBA standards.

Literacy and ELA

At kindergarten-entry and in 3rd grade, t-tests found there was a significant opportunity gap in literacy by gender, M/EL status, income, SWD status, regular attendance, discipline, race/ethnicity, and LAP status (Figures 23–30). By third grade, these gaps had widened for all except income and regular attendance, where they remained virtually the same.

Within most groups, the widening gap could be attributed to the group with higher Kindergarten readiness improving and the other group losing ground by 3rd grade. However, with Multilingual/English learners, it appears that the performance of students whose native language is English remains constant and does not improve (Figure 24). Consequently, the widening gap appears attributable to M/EL students falling behind. The widest gap in kindergarten literacy is between students who did and did not receive LAP services (.72 standard deviations). By 3rd grade, the widest gap is between M/ELs and students whose native language is English (.93 standard deviations), though the opportunity gap by LAP status remains large too (.91 standard deviations). This is expected given that students receive M/EL and LAP services if they are struggling academically.

In terms of the greatest percent change in z-score gap from kindergarten to 3rd grade, the discipline gap increased by 174%. This figure may be skewed because only a small number of students were suspended or expelled. The second largest gap was between students with and without disabilities, which increased by 75%.

In kindergarten, there were highly significant literacy opportunity gaps between students who identify as White and students who identify as race/ethnicities other than Asian (Figure 30). By 3rd grade, the gaps between White and American Indian/Alaskan Native, Black/African American and Two or More Races students widened. But for Hispanic/Latino students, it narrowed, though remaining significant. The gap between White and Native Hawaiian/Other Pacific Islander remained constant. While there was no significant difference between Asian and White student performance in kindergarten, a significant gap emerged in 3rd grade favoring Asian students.

Figure 23: Gender Opportunity Gap in Literacy

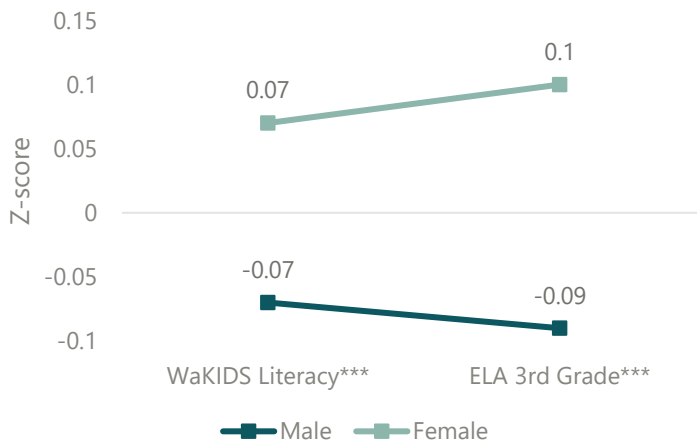


Figure 24: M/EL Status Opportunity Gap in Literacy

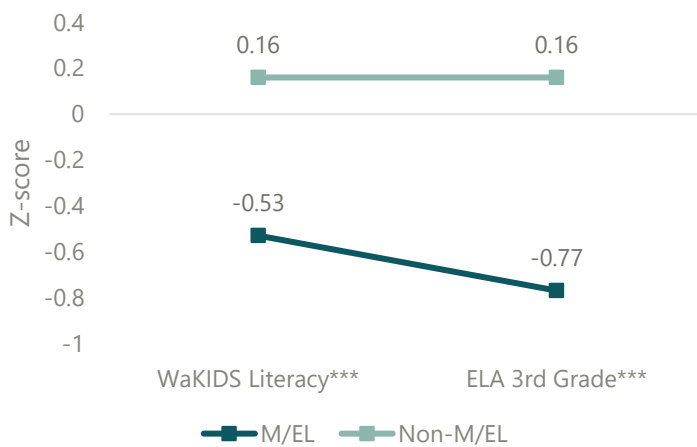


Figure 25: Income Opportunity Gap in Literacy

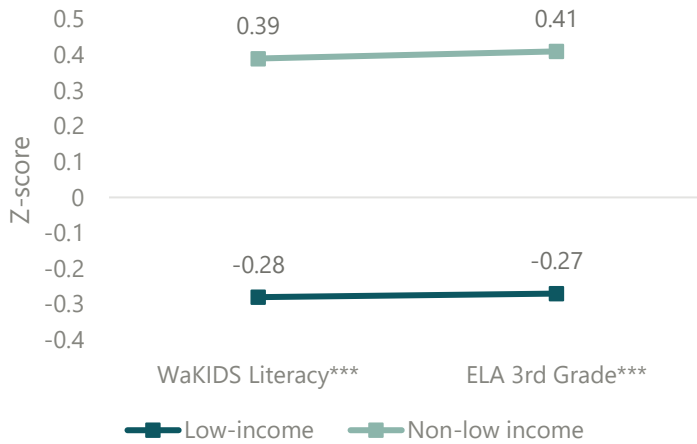


Figure 26: SWD Status Opportunity Gap in Literacy

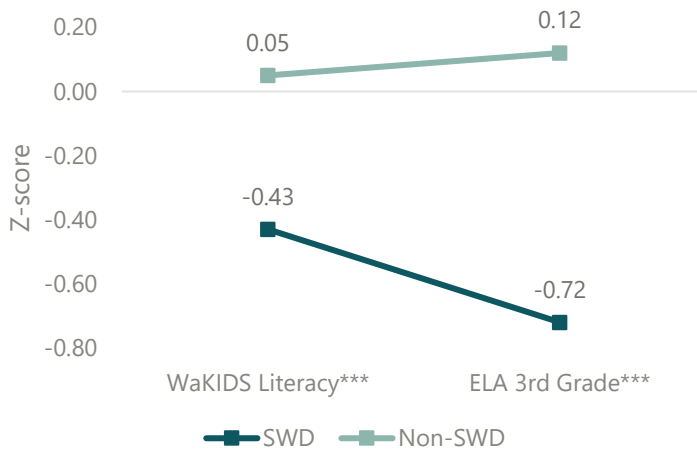


Figure 27: Regular Attendance Opportunity Gap in Literacy

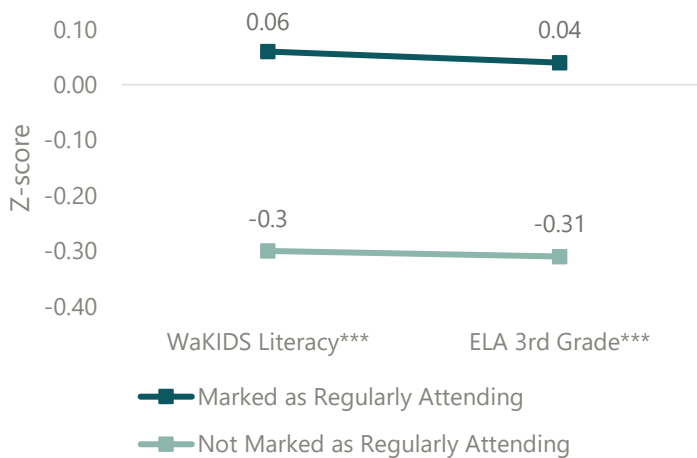


Figure 28: Discipline Opportunity Gap in Literacy

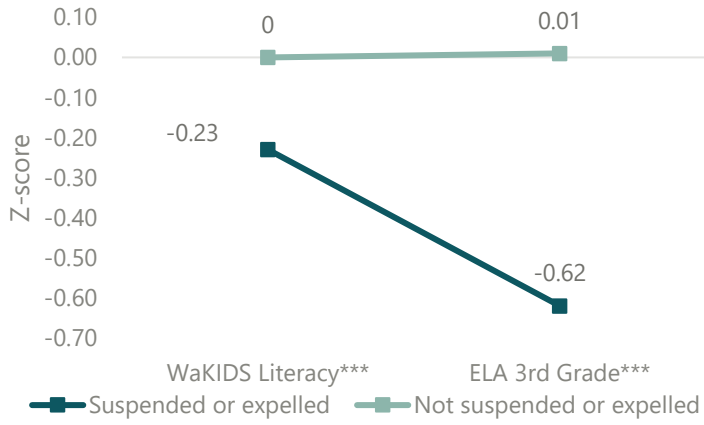


Figure 29: LAP Status Opportunity Gap in Literacy

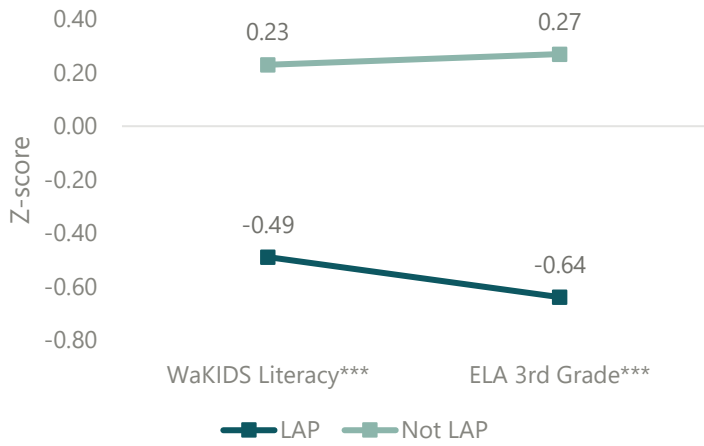
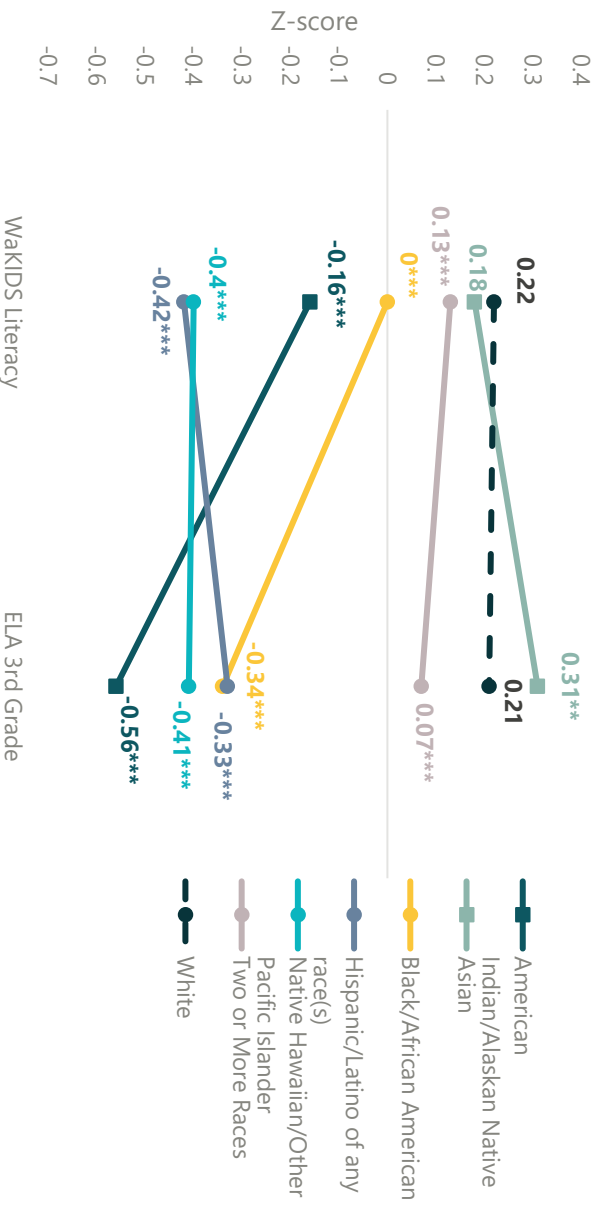


Figure 30: Racial/Ethnic Opportunity Gap in Literacy



*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$ based on *t*-tests

Math

In math, there were significant opportunity gaps at kindergarten-entry by M/EL status, income, SWD status, regular attendance, discipline and LAP status. Each gap remained significant in 3rd grade and widened (Figures 31–38). However, while there was no significant gap between male and female students in kindergarten, a slight gap emerged in 3rd grade, favoring male students (Figure 31).

The widest gap in kindergarten math ability is between Multilingual/English learners and students who are not Multilingual/English learners (.67 standard deviations) and the widest gap in 3rd grade is between students with and without disabilities (.89 standard deviations). In terms of the greatest percent change in z-score gap from kindergarten to 3rd grade, the discipline gap increased by 225%. Additionally, the gender gap increased by 200% to become significant in 3rd grade, and the gap between students with and without disabilities widened by 93%.

Racial/ethnic math opportunity gaps also mirror those in literacy (Figure 38). There are significant gaps between non-White (except Asian) and White students in kindergarten, and these gaps widen by 3rd grade except for Hispanic/Latino students, where the gap narrows but remains significant. By 3rd grade, there was a significant gap between Asian and White students. In both literacy and math, the White-Black/African American and White-American Indian/Alaskan Native opportunity gaps widen the most.

Figure 31: Gender Opportunity Gap in Math

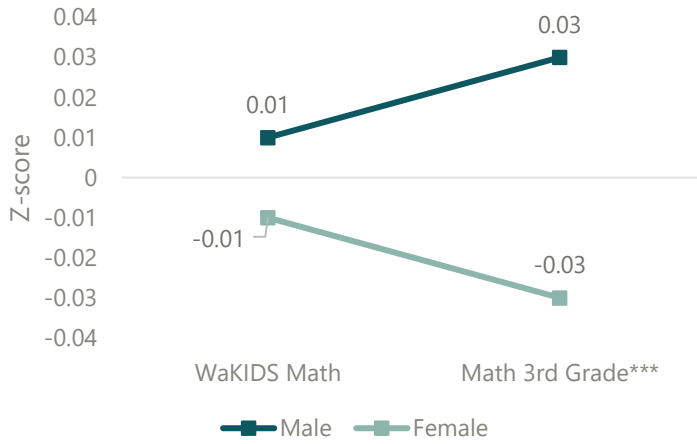


Figure 32: M/EL Status Opportunity Gap in Math

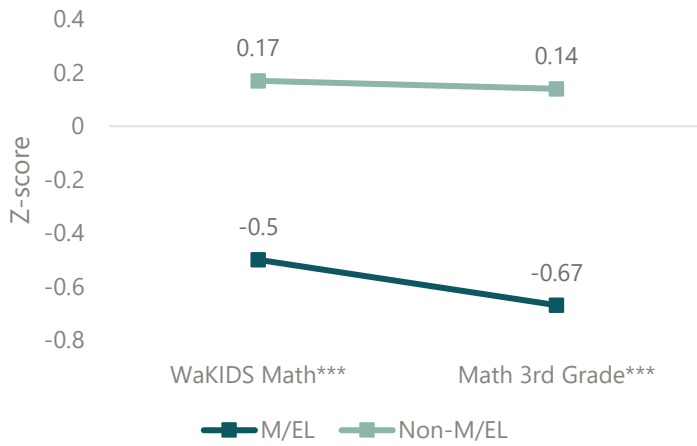


Figure 33: Income Opportunity Gap in Math

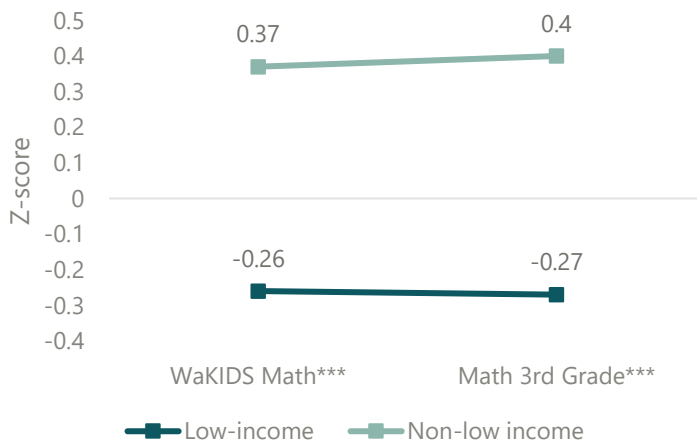


Figure 34: SWD Status Opportunity Gap in Math

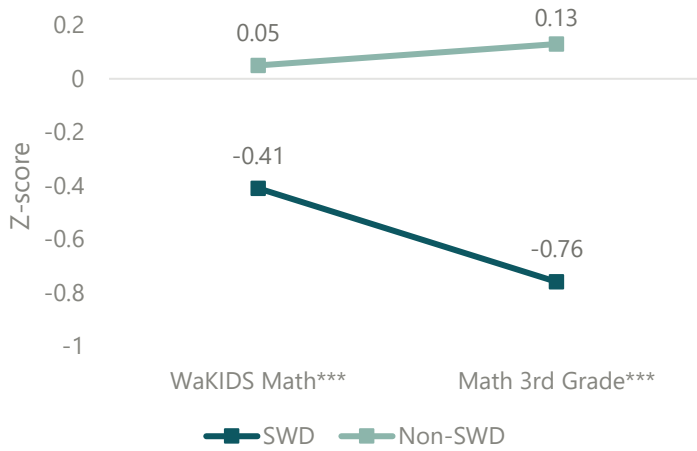


Figure 35: Regular Attendance Opportunity Gap in Math

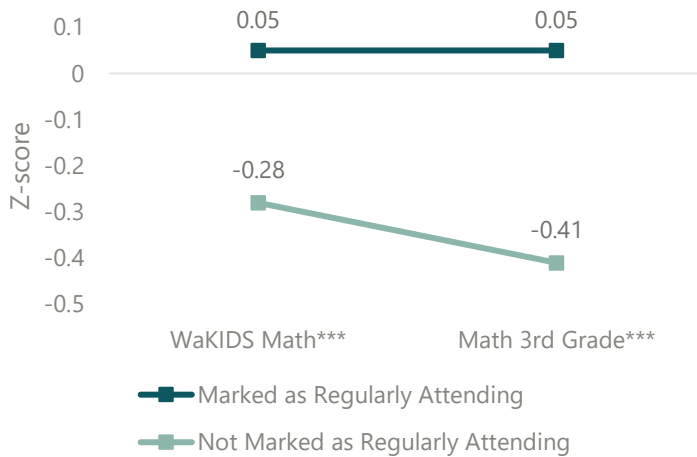


Figure 36: Discipline Opportunity Gap in Math

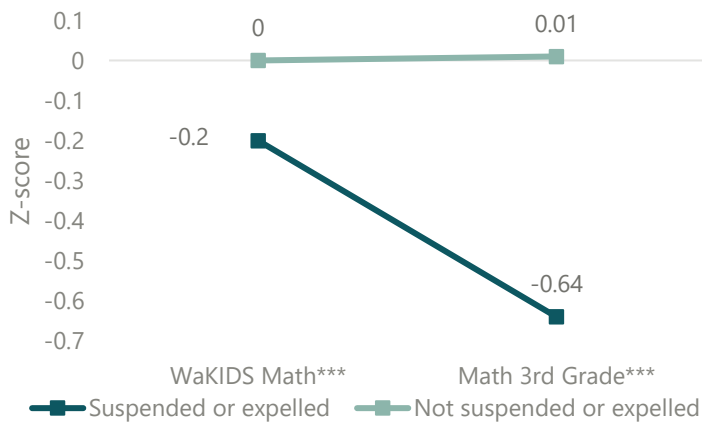


Figure 37: LAP Status Opportunity Gap in Math

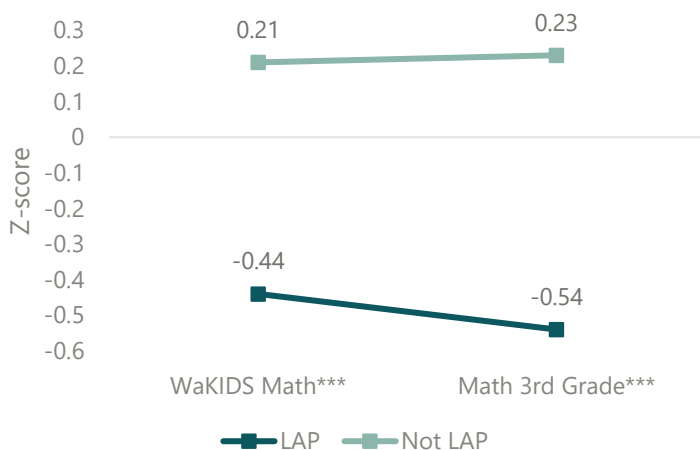
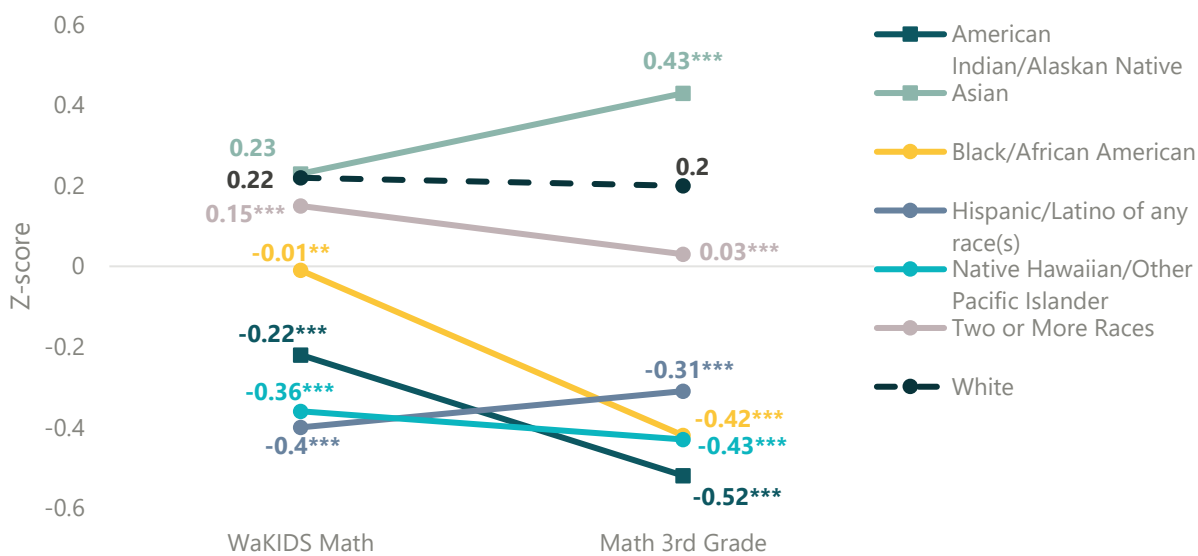


Figure 38: Racial/Ethnic Opportunity Gap in Math



Identifying Students Who Were Kindergarten-Ready but Did Not Meet 3rd Grade SBA Standards

Many students entered kindergarten with developmentally and age-appropriate skillsets. This should have theoretically set them up for success. Despite this, some students did not meet standards on their 3rd grade SBAs. Tables 3 and 4 identify students who, despite entering kindergarten with the same high skill levels as their peers appear to not be receiving sufficient educational supports.

Students who entered kindergarten with strong skills in literacy and math but did not meet 3rd grade SBA standards were significantly more likely to be American Indian/Alaskan Native, Black/African American, Hispanic/Latino of any race(s), Native Hawaiian/Other Pacific Islander, Multilingual/English learners, from low-income families, students with disabilities, not have

regular attendance, been suspended or expelled, received LAP services and changed schools more often. Additionally, female students appear more likely to fall behind in math, and male students in literacy/ELA.

Figure 39: Student Performance in Kindergarten Literacy and 3rd Grade ELA SBA

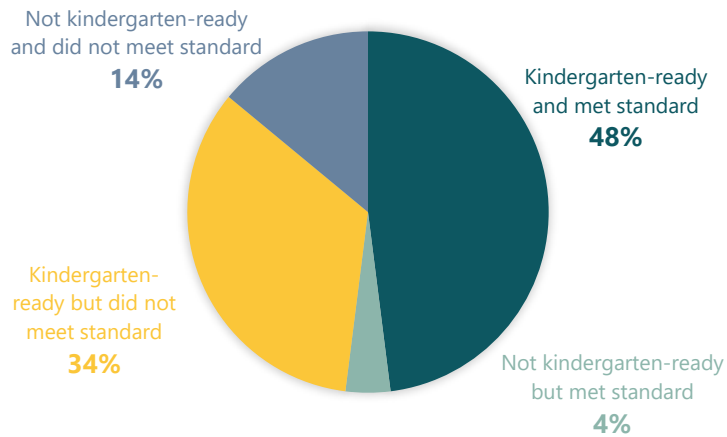


Figure 40: Student Performance in Kindergarten Math and 3rd Grade Math SBA

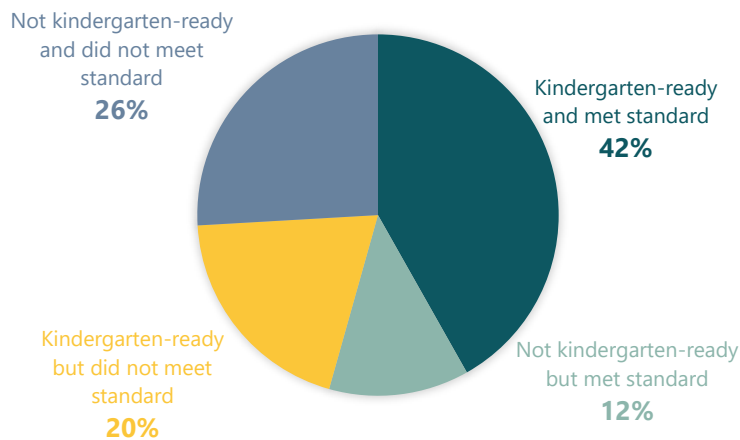


Table 3: Comparing Characteristics of Students Who Were Kindergarten-Ready in Literacy by 3rd Grade ELA SBA Performance

	Did Not Meet Standard	Met Standard
Gender***		
Female	46.9%	53.3%
Male	53.1%	46.7%

	Did Not Meet Standard	Met Standard
Race/ethnicity***		
American Indian/Alaskan Native	2.2%	0.8%
Asian	3.6%	5.9%
Black/African American	5.2%	2.8%
Hispanic/Latino of any race(s)	32.2%	19.3%
Native Hawaiian/Other Pacific Islander	1.4%	0.7%
Two or More Races	9.3%	9.9%
White	46.1%	60.6%
Students in Multilingual/English Learner programs***	20.4%	4.0%
Students not in Multilingual/English Learner programs	79.6%	96.0%
Students from low-income families***	68.8%	43.3%
Students from not low-income families	31.2%	56.7%
Students with disabilities***	19.0%	6.0%
Students without disabilities	81.0%	94.0%
Marked as regularly attending***	86.6%	92.0%
Not marked as regularly attending	13.3%	7.9%
Suspended or expelled ***	2.7%	0.9%
Not suspended or expelled	97.3%	99.1%
Received LAP services***	45.5%	11.6%
Did not receive LAP services	54.5%	88.4%
Mobility (number of school changes) ***		
0	58.0%	62.5%
1	31.2%	29.6%
2+	10.8%	7.9%

	Did Not Meet Standard	Met Standard
Number of years student was eligible for FRPM***		
0	24.1%	49.1%
1	2.9%	3.3%
2	5.5%	6.0%
3	9.5%	8.0%
4	57.9%	33.5%
Number of years student had regular attendance ***		
0	3.2%	1.7%
1	4.8%	2.7%
2	8.3%	5.6%
3	17.2%	14.4%
4	66.5%	75.5%

Chi-squared tests *** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$.

Table 4: Comparing Characteristics of Students Who Were Kindergarten-Ready in Math by 3rd Grade Math SBA Performance

	Did Not Meet Standard	Met Standard
Gender***		
Female	51.5%	48.5%
Male	48.5%	51.5%
Race/ethnicity***		
American Indian/Alaskan Native	1.9%	0.8%
Asian	3.1%	6.2%
Black/African American	5.8%	2.7%
Hispanic/Latino of any race(s)	30.2%	18.5%

	Did Not Meet Standard	Met Standard
Native Hawaiian/Other Pacific Islander	1.2%	0.6%
Two or More Races	9.8%	9.7%
White	48.0%	61.5%
Students in Multilingual/English learner programs***	15.9%	4.4%
Students not in Multilingual/English Learner programs	84.1%	95.6%
Students from low-income families***	66.0%	41.3%
Students from not low-income families	34.0%	58.7%
Students with disabilities***	15.8%	6.1%
Students without disabilities	84.2%	93.9%
Marked as regularly attending***	85.8%	93.0%
Not marked as regularly attending	14.0%	7.0%
Suspended or expelled ***	2.9%	1.0%
Not suspended or expelled	97.1%	99.0%
Received LAP services***	40.3%	12.7%
Did not receive LAP services	59.7%	87.3%
Mobility (number of school changes) ***		
0	56.6%	63.0%
1	32.2%	29.4%
2+	11.2%	7.6%
Number of years student was eligible for FRPM***		
0	26.6%	51.2%
1	3.1%	3.3%
2	5.9%	6.1%
3	9.9%	7.6%

	Did Not Meet Standard	Met Standard
4	54.5%	31.8%
Number of years student had regular attendance ***		
0	3.6%	1.3%
1	5.0%	2.3%
2	8.1%	5.2%
3	17.7%	13.7%
4	65.6%	77.5%

*Chi-squared tests ***p < 0.001 **p < 0.01 *p < 0.05.*

Regression Results: Kindergarten Readiness Predicts 3rd Grade ELA and Math SBA Proficiency

Kindergarten readiness strongly predicted whether students met 3rd grade SBA standards, even after controlling for student characteristics. Literacy, math, and cognitive kindergarten readiness significantly increased the odds of students meeting SBA standards in both ELA and math (Table 5). Readiness in the physical domain predicted slightly lower odds of meeting ELA standards, while social-emotional predicted higher odds of meeting math standards. After including student characteristics, language readiness was no longer a significant predictor.

Readiness in math was the strongest kindergarten predictor of meeting math SBA standards, likewise for literacy and ELA. Holding all other variables constant, for the average student in the average school, the odds of meeting ELA standards were 1.62 times greater for students who were kindergarten-ready in literacy compared to students who were not. Likewise, the odds of meeting math standards were 1.72 times greater for students who were kindergarten-ready in math, compared to their non-ready peers.

Some student groups were less likely to meet standards than their peers, even after controlling for kindergarten readiness. For example, holding all other variables constant, the odds of meeting math standards were 51% lower for the average Black/African American student in the average school compared to White students.

Receiving M/EL, SWD and LAP services in 3rd grade was also associated with much lower likelihoods of meeting standard in either subject. For example, holding all other variables constant, the odds of students who received M/EL, SWD or LAP services meeting ELA standards were 70%, 72% and 84% lower than their peers who did not receive services, respectively. Greater school mobility and being suspended or expelled in 3rd grade were also associated with poorer odds, though not to the same degree. There also appeared to be compounding effects

of income and regular attendance over time. On average, the odds of meeting ELA and math standards were 15% and 14% lower for each additional year a student was eligible for Free and Reduced Price Meals between kindergarten and 3rd grade, compared to students who were never eligible. However, on average, the odds of meeting ELA and math standards were 8% and 20% greater for each additional year a student had regular attendance, compared to students who were never regular attenders.

This analysis used multilevel modeling and random intercept models to account for variation between schools. The final model variance partition coefficients indicate that only 11% (ELA) and 13% (Math) of remaining variance in the model can be attributed to unidentified school-level factors (Table 5). This is a fairly low proportion considering the current model does not include any school-level factors. In other words, most of the remaining variation in the likelihood of meeting SBA standards is attributable to student-level factors unaccounted for in this model.

In the first models, only kindergarten readiness indicators are included and the associations with SBA outcomes are stronger than in the final models that include student characteristics (Appendix, Tables A2 and A4). Including “post-treatment” variables (variables based on post-kindergarten data) may be biasing the kindergarten readiness coefficients downwards in the second and third models. Alternatively, omitting these variables in the first model may also be inducing bias. While identifying which biases are driving these changes is beyond the current scope of this study, it presents opportunities for future analysis. Results from initial analyses of the association between “post-treatment” variables and kindergarten readiness did not find overwhelming evidence for omitting these variables (Appendix, Table A1).

Table 5: Odds Ratios of Meeting 3rd Grade SBA Standards Based on Final Models

	ELA	Math
Intercept	0.97	0.89
Student characteristics		
WaKIDS Literacy	1.62***	1.51***
WaKIDS Math	1.55***	1.72***
WaKIDS Cognitive	1.38***	1.42***
WaKIDS Language	1.01	0.93
WaKIDS Social-emotional	1.06	1.15***
WaKIDS Physical	0.90**	1.04
WaKIDS readiness in all domains	1.31***	1.28***
Female	1.25***	0.69***

	ELA	Math
American Indian/Alaskan Native	0.54***	0.64***
Asian	1.34***	1.58***
Black/African American	0.61***	0.49***
Hispanic/Latino of any race(s)	0.93*	0.80***
Native Hawaiian/Other Pacific Islander	0.66***	0.69**
Two or More Races	0.90*	0.83***
Multilingual/English learner in 3rd grade	0.30***	0.46***
Number of years student was eligible for FRPM	0.85***	0.86***
Student had an IEP (SWD) in 3rd grade	0.28***	0.29***
Number of years student had regular attendance	1.08***	1.20***
Suspended or expelled in 3rd grade	0.61***	0.62***
Received LAP services in 3rd grade	0.16***	0.23***
Mobility (Number of school changes)		
1	0.92**	0.89***
2+	0.82***	0.75***
School level random effects		
Intercept variance	0.40	.49
Student level random effects		
Intercept variance	3.29	3.29
Variance partition coefficient	.11	.13
Log-likelihood	-21,010***	-21,528***
Units: Students	41,861	41,861
Units: Schools	1,160	1,160

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$; Reference groups in order of variables listed: Not kindergarten-ready in various domains, Male, White, native English speaker, never eligible for FRPM, student without disability, no suspension/expulsion, never had regular attendance, didn't receive LAP services, never changed schools.

CONCLUSION

Findings from this study support existing research that has found kindergarten readiness to be a significant predictor of later academic achievement. While math and literacy kindergarten readiness were the strongest predictors in the corresponding SBA subjects, there were also cross-domain effects that included non-cognitive skills such as social-emotional readiness. However, the results also support existing research that indicates that not all student groups start school with similar skill levels and that opportunity gaps generally widen over time. The analysis also provides additional evidence that program services, disciplinary incidences, school mobility, and cumulative years of being eligible for FRPM and having regular attendance are also significant factors in academic achievement.

Several nuanced results include that female and male students had similar levels of kindergarten readiness in math, but a gap emerged by 3rd grade favoring male students, mirroring Robinson and Lubienski's (2011) findings. Additionally, Hispanic/Latino students were the only racial/ethnic group to experience a narrowing of the opportunity gap between kindergarten and 3rd grade, although it remained significant, similar to results found by Levitt and Fryer (2004; 2006).

Kindergarten readiness is undoubtedly important for later academic success. But for some students, even entering school with strong skills is not enough to guarantee achievement and progression over the course of time. These findings should prompt reflection on how school policy and programming can adapt to meet the needs of these students and address structural inequities and implicit bias within the education system, beginning at an early age.

LIMITATIONS

This study has several limitations. First, findings rely on data from one cohort of kindergarteners that was not a representative or random sample of students in Washington. Instead, several student groups were overrepresented due to the incomplete roll-out of WaKIDS by 2015–16. These findings would be more robust if additional analyses looked at different cohorts or followed the same cohort through additional years to see if kindergarten readiness remained a significant predictor of achievement. However, changes to the WaKIDS assessment over the years and interruptions of in-person teaching and SBA testing due to COVID-19 may make direct comparisons across cohorts difficult.

Additionally, data were limited to those collected by OSPI. Home, community and environmental factors that previous literature has shown to be connected to academic outcomes such as parents' level of education, access to early learning programs, or neighborhood poverty were not accounted for. As such, variables such as race/ethnicity act as surrogates for the effect experienced by certain groups that have historically had less equitable access to resources that support children's development. Furthermore, racial/ethnic aggregation at the level used in this study obscures differences within categories (e.g. Asian student achievement could be further broken down into Korean, Laotian, Bhutanese, etc.). Similarly, the federal race/ethnicity reporting

requirement of the Hispanic/Latino ethnicity rolls-up in a way that would benefit from a more nuanced examination of results. For example, American Indian/Alaskan Native students who also ethnically identify as Hispanic/Latino are only counted under the Hispanic/Latino category.

Students who received M/EL, LAP and SWD services are included regardless of the type or length of services received. Eligibility for these services is generally conditional on a student struggling to meet grade level standards in a traditional learning environment. This would suggest a lower likelihood of meeting SBA standards. However, eligibility results in interventions that ideally give these students the supports to improve academically. Similarly, the discipline indicator does not distinguish between offense types or exclusionary length. After an exclusionary discipline incident, there are ideally interventions to support the student. In this current analysis, it is impossible to disentangle the effects of eligibility and intervention. It also shouldn't be assumed that the effect of 3rd grade M/EL, LAP or SWD services is the same as if a student received services in earlier grades. Intermediate variable bias may also be an issue since kindergarten readiness may influence if a student receives these services (Appendix).

Furthermore, as observational and summative assessments, WaKIDS and the SBA require students to display knowledge in very different ways. This should be kept in mind when interpreting findings from this study and making direct comparisons between assessments. Additionally, although OSPI has access to statewide data, administrative data is not inherently without bias. For example, WaKIDS scoring may have been impacted by factors such as the quality and recentness of the teacher's WaKIDS training, their early learning knowledge, implicit bias or the level of support educators received while conducting the WaKIDS assessment from school administrators. In fact, a 2013 inter-rater reliability study of WaKIDS found that teachers were more likely to accurately measure development skills if the student was typically developing and a native English speaker (Soderberg et al., 2013).

Finally, after completion of the analysis and just prior to publication of this research brief, OSPI learned there were changes to the readiness cut scores used by Teaching Strategies GOLD® across school years relevant to this study. Although the changes are not insignificant, initial review indicates that they do not substantially impact the patterns or trends observed in this analysis. Future analysis will address this issue more comprehensively.

FUTURE ANALYSIS

In a follow-up to this research brief, additional data on educators (e.g. certification, years of experience, race/ethnicity) will be included in a similar analysis to determine if educator traits help further explain differences in SBA outcomes. Existing research suggests that higher levels of achievement may be associated with teachers who have more experience, relevant certification and advanced degrees, which is concerning if qualified educators are less likely to work in low-income neighborhoods (Boyd et al., 2008; Croninger et al., 2007; Easton-Brooks and Davis, 2009). Additionally, students may benefit from having teachers who represent their backgrounds. Some studies have found that particularly for students of color, having a teacher of the same race or socioeconomic background can reduce the effects of bias and stereotype threat that present a barrier to learning (Clotfelter et al., 2004; Dee, 2004).

Future analyses could also:

- Explore interactions between different student characteristics such as race/ethnicity and income.
- Include more community, home or school-level factors.
- Compare these results to other WaKIDS kindergarten cohorts or follow the same cohort through later grade levels.
- Determine if certain indicators within each WaKIDS domain are better at predicting SBA outcomes.
- Identify predictors of WaKIDS kindergarten readiness.
- Identify variability in teachers' WaKIDS scoring and differences between student groups.

APPENDIX: DATA

If there were duplicate WaKIDS records for the same student (e.g. they changed schools early in the year and were assessed twice), their best results were used. To be included in the matched cohort, students who had WaKIDS records needed to be matched by SSID to enrollment records and 3rd grade 2018–19 SBA results. If a student had multiple SBA attempts, their best results were used. 568 students who did not take the ELA and math SBA at the same school were excluded from the analysis (0.7% of the sample).

Intermediate Variable Bias from “Post-Treatment” Variables

Intermediate variable bias presents a potentially significant limitation of this analysis. If the value of “post-treatment” variables, variables based on post-kindergarten data, is related to kindergarten readiness, including them in the regression models may bias the strength of the association between kindergarten readiness and meeting SBA standards, as indicated by the WaKIDS model coefficients. For example, this may be the case if students who were not kindergarten-ready in math were consequently more likely to be enrolled in LAP services. This could mean that the final model coefficients don’t accurately capture the average direct controlled effect of kindergarten readiness on SBA proficiency.

Table A5 reports associations between the kindergarten readiness and “post-treatment” variables. While higher values such as those for M/EL status and WaKIDS literacy, math, language and all domains; LAP status and WaKIDS math; and years student was eligible for FRPM and WaKIDS literacy, math and all domains raise some concerns, none exceed the medium effect size threshold (0.30) (Cohen, 1988).

Table A1: Associations Between WaKIDS and “Post-Treatment” Variables

	M/EL Status	SWD Status	LAP Status	Discipline	Mobility	Years Eligible for FRPM	Years of Regular Attendance
WaKIDS Literacy	0.29	0.18	0.2	0.04	0.02	-0.24	0.11
WaKIDS Math	0.30	0.18	0.24	0.03	0.02	-0.29	0.12
WaKIDS Cognitive	0.21	0.21	0.16	0.06	0.03	-0.2	0.09
WaKIDS Language	0.27	0.22	0.16	0.03	0.01	-0.2	0.08
WaKIDS Social-emotional	0.11	0.22	0.1	0.1	0.04	-0.14	0.08
WaKIDS Physical	0.08	0.17	0.08	0.04	0.02	-0.11	0.08

	M/EL Status	SWD Status	LAP Status	Discipline	Mobility	Years Eligible for FRPM	Years of Regular Attendance
WaKIDS readiness in all domains	0.25	0.2	0.21	0.06	0.05	-0.26	0.11

Cramer's V coefficients: M/EL, SWD, LAP, Discipline, Mobility; Point-biserial correlations coefficients: Years low-income and years regular attendance.

Table A2: Multilevel Logistic Regression Log-Odds of Meeting 2018–19 3rd Grade ELA SBA Standard

	Model 1 (SE)	Model 2 (SE)	Model 3 (SE)
Fixed effects			
Intercept	-1.75(.05)***	-1.58(.05)***	-0.03(.08)
Student characteristics			
WaKIDS Literacy	0.8(.04)***	0.74(.04)***	0.48(.04)***
WaKIDS Math	0.72(.03)***	0.7(.03)***	0.44(.04)***
WaKIDS Cognitive	0.38(.04)***	0.38(.04)***	0.32(.04)***
WaKIDS Language	0.29(.04)***	0.26(.04)***	0.01(.04)
WaKIDS Social-emotional	0.14(.03)***	0.13(.03)***	0.06(.04)
WaKIDS Physical	-0.17(.03)***	-0.18(.03)***	-0.10(.04)**
WaKIDS readiness in all domains	0.45(.04)***	0.42(.04)***	0.27(.04)***
Female		0.27(.02)***	0.22(.03)***
American Indian/Alaskan Native		-1.07(.11)***	-0.62(.12)***
Asian		0.25(.06)***	0.29(.06)***
Black/African American		-0.75(.06)***	-0.50(.07)***
Hispanic/Latino of any race(s)		-0.51(.03)***	-0.07(.03)*
Native Hawaiian/Other Pacific Islander		-0.75(.11)***	-0.42(.12)***
Two or More Races		-0.17(.04)***	-0.1(.04)*
Multilingual/English learner in 3rd grade			-1.22(.04)***

	Model 1 (SE)	Model 2 (SE)	Model 3 (SE)
Number of years student was eligible for FRPM			-0.16(.01)***
Student had an IEP (SWD) in 3rd grade			-1.29(.04)***
Number of years student had regular attendance			0.08(.01)***
Suspended or expelled in 3rd grade			-0.49(.10)***
Received LAP services in 3rd grade			-1.84(.03)***
Mobility (Number of school changes)			
1			-0.08(.03)**
2+			-0.20(.05)***
School level random effects			
Intercept variance	0.36	0.31	0.40
Student level random effects			
Intercept variance	3.29	3.29	3.29
Variance partition coefficient	.10	.09	.11
Log-likelihood	-24,914.4***	-24,568.3***	-21,010***
Units: Students	41,867	41,861	41,861
Units: Schools	1,160	1,160	1,160

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$; Reference groups in order of variables listed: Not kindergarten-ready in various domains, Male, White, native English speaker, never eligible for FRPM, student without disability, no suspension/expulsion, never had regular attendance, didn't receive LAP services, never changed schools.

Table A3: Odds Ratios of Meeting 2018–19 3rd Grade ELA SBA Standard

	Model 1	Model 2	Model 3
Intercept	0.17***	0.21***	0.97
Student characteristics			
WaKIDS Literacy	2.23***	2.10***	1.62***
WaKIDS Math	2.05***	2.01***	1.55***
WaKIDS Cognitive	1.46***	1.46***	1.38***

	Model 1	Model 2	Model 3
WaKIDS Language	1.34***	1.30***	1.01
WaKIDS Social-emotional	1.15***	1.14***	1.06
WaKIDS Physical	0.84***	0.84***	0.90**
WaKIDS readiness in all domains	1.57***	1.52***	1.31***
Female		1.31***	1.25***
American Indian/Alaskan Native		0.34***	0.54***
Asian		1.28***	1.34***
Black/African American		0.47***	0.61***
Hispanic/Latino of any race(s)		0.60***	0.93*
Native Hawaiian/Other Pacific Islander		0.47***	0.66***
Two or More Races		0.84***	0.90*
Multilingual/English learner in 3rd grade			0.30***
Number of years student was eligible for FRPM			0.85***
Student had an IEP (SWD) in 3rd grade			0.28***
Number of years student had regular attendance			1.08***
Suspended or expelled in 3rd grade			0.61***
Received LAP services in 3rd grade			0.16***
Mobility (Number of school changes)			
1			0.92**
2+			0.82***

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$; Reference groups in order of variables listed: Not kindergarten-ready in various domains, Male, White, native English speaker, never eligible for FRPM, student without disability, no suspension/expulsion, never had regular attendance, didn't receive LAP services, never changed schools.

Table A4: Multilevel Logistic Regression Log-Odds of Meeting 2018–19 3rd Grade Math SBA Standard

	Model 1 (SE)	Model 2 (SE)	Model 3 (SE)
Fixed effects			
Intercept	-1.58(.05)***	-1.24(.05)***	-0.12(.08)
Student characteristics			
WaKIDS Literacy	0.69(.04)***	0.65(.04)***	0.41(.04)***
WaKIDS Math	0.82(.03)***	0.76(.03)***	0.54(.04)***
WaKIDS Cognitive	0.39(.04)***	0.4(.04)***	0.35(.04)***
WaKIDS Language	0.18(.04)***	0.16(.04)***	-0.07(.04)
WaKIDS Social-emotional	0.17(.03)***	0.22(.03)***	0.14(.04)***
WaKIDS Physical	-0.07(.03)***	-0.03(.03)***	0.04(.04)
WaKIDS readiness in all domains	0.40(.04)***	0.4(.04)***	0.25(.04)***
Female		-0.24(.02)***	-0.37(.03)***
American Indian/Alaskan Native		-0.89(.11)***	-0.45(.11)***
Asian		0.46(.06)***	0.46(.07)***
Black/African American		-0.93(.06)***	-0.71(.07)***
Hispanic/Latino of any race(s)		-0.55(.03)***	-0.22(.03)***
Native Hawaiian/Other Pacific Islander		-0.73(.11)***	-0.37(.12)**
Two or More Races		-0.26(.04)***	-0.19(.04)***
Multilingual/English learner in 3rd grade			-0.78(.04)***
Number of years student was eligible for FRPM			-0.15(.01)***
Student had an IEP (SWD) in 3rd grade			-1.25(.04)***
Number of years student had regular attendance			0.18(.09)***
Suspended or expelled in 3rd grade			-0.48(.01)***
Received LAP services in 3rd grade			-1.47(.03)***

	Model 1 (SE)	Model 2 (SE)	Model 3 (SE)
Mobility (Number of school changes)			
1			-0.12(.03)***
2+			-0.29(.09)***
School level random effects			
Intercept variance	.43	.40	.49
Student level random effects			
Intercept variance	3.29	3.29	3.29
Variance partition coefficient	.12	.11	.13
Log-likelihood	-24,654***	-24,240***	-21,528***
Units: Students	41,867	41,861	41,861
Units: Schools	1,160	1,160	1,160

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$; Reference groups in order of variables listed: Not kindergarten-ready in various domains, Male, White, native English speaker, never eligible for FRPM, student without disability, no suspension/expulsion, never had regular attendance, didn't receive LAP services, never changed schools.

Table A5: Odds Ratios of Meeting 2018–19 3rd Grade Math SBA

	Model 1	Model 2	Model 3
Intercept	0.21***	0.29***	0.89
Student characteristics			
WaKIDS Literacy	1.99***	1.92***	1.51***
WaKIDS Math	2.27***	2.14***	1.72***
WaKIDS Cognitive	1.48***	1.49***	1.42***
WaKIDS Language	1.20***	1.17***	0.93
WaKIDS Social-emotional	1.19***	1.25***	1.15***
WaKIDS Physical	0.93*	0.97	1.04
WaKIDS readiness in all domains	1.49***	1.49***	1.28***
Female		0.79***	0.69***

	Model 1	Model 2	Model 3
American Indian/Alaskan Native		0.41***	0.64***
Asian		1.58***	1.58***
Black/African American		0.39***	0.49***
Hispanic/Latino of any race(s)		0.58***	0.80***
Native Hawaiian/Other Pacific Islander		0.48***	0.69**
Two or More Races		0.77***	0.83***
Multilingual/English learner in 3rd grade			0.46***
Number of years student was eligible for FRPM			0.86***
Student had an IEP (SWD) in 3rd grade			0.29***
Number of years student had regular attendance			1.20***
Suspended or expelled in 3rd grade			0.62***
Received LAP services in 3rd grade			0.23***
Mobility (Number of school changes)			
1			0.89***
2+			0.75***

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$; Reference groups in order of variables listed: Not kindergarten-ready in various domains, Male, White, native English speaker, never eligible for FRPM, student without disability, no suspension/expulsion, never had regular attendance, didn't receive LAP services, never changed schools.

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